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ABSTRACT

The Computer Study Committee was formed under the Board of Regents in Kansas to determine the presence and use of computers in the seven state institutions. To collect data, the Committee sent out questionnaires, made campus visits and conducted interviews. The bulk of the report discusses (1) funding and accounting procedures for computer use and services at the institutions; (2) the need for computer science education and various programs at the institutions; (3) computer hardware presently available for administrative purposes and the need for centralization and statewide network computing; (4) computing center space facilities in the seven institutions; (5) computer usage in institutional and Regents' reporting and planning, and interinstitutional cooperation on data processing problems; and (6) computer center staffing problems. The report includes seventeen recommendations, including the establishment of a permanent Computer Advisory Committee. The questionnaire is appended. (AF)

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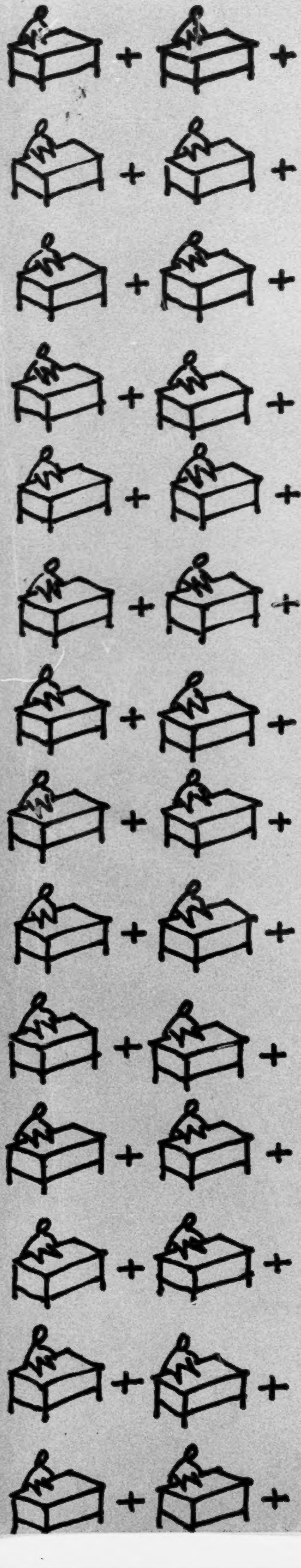

Report of the COMPUTER STUDY COMMITTEE

submitted to the

BOARD OF REGENTS
STATE OF KANSAS

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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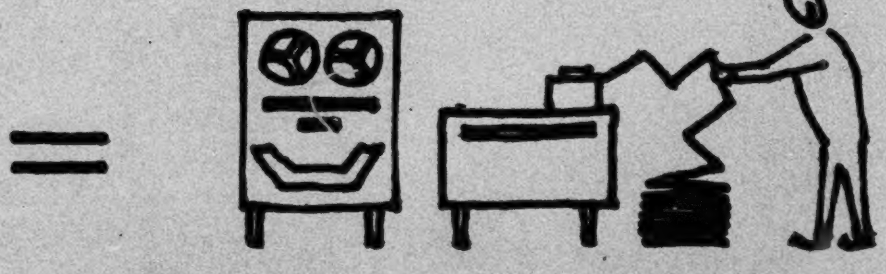

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BOARD OF REGENTS

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June 18, 1969

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Mr. C. N. Cushing, Chairman
Board of Regents, State of Kansas
State Office Building
Topeka, Kansas 66612

Dear Mr. Cushing:

Last fall you established the Regents' Computer Study Committee and asked us to conduct a survey to determine the present inventory of computer equipment, develop some guidelines for the use of such equipment and, if at all possible, to develop comprehensive policy statements for the future of computer installations in the state universities and colleges.

The conclusions, recommendations and information in this report which we now present to you, are designed to meet this important assignment. The report is the result of numerous meetings, campus visits and intensive study of the difficult and complex computing problems facing higher education in Kansas.

The committee is most grateful for the courtesy, close cooperation, assistance and candor of the various college and university officials interviewed who gave freely of their time for conversations and discussions. We take this opportunity to thank them publicly for their hospitality.

It has been a privilege to prepare this report for you and the Board of Regents.

Cordially,

COMPUTER STUDY COMMITTEE

Philip E. Arnold

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PREFACE

In response to a request by Mr. C. N. Cushing, Chairman of the Board of Regents, Max Bickford, Executive Officer of the Board, on August 5, 1968, sent a memorandum to Chancellor Wescoe of the University of Kansas, President McCain of Kansas State University and President Lindquist of Wichita State University, requesting each of them to appoint one man from his faculty "to work with Mr. Phil Arnold in determining our present inventory of computer equipment and developing some guidelines for the use of such equipment and, if at all possible, to develop comprehensive policy statements for the future of computer installations in the State universities."

The Committee met for the first time at the Office of the Board of Regents on September 26, 1968. It spent this and several subsequent meetings in organizing itself and determining the direction its study would take. (Minutes of these meetings were prepared by Mr. Arnold and are on file in the Regents' Office.)

It did not take the Committee long to discover there were many patterns of development, common problems, and various solutions to administrative data-processing, instruction and research computing in the Kansas institutions. The principal differences among the institutions were the size and budgets of the institutions, the historical stage of development of computers on the campus, internal politics and personality differences, the extent of the research activity, and varying educational and administrative philosophies.

The Committee also discovered that conversations on the subject of computers quickly raised many complex problems of staffing, funding and financing the computational center, space, equipment, and the teaching of computer science. At most institutions, the role and impact of the computer generated much interest and excitement. All those interviewed during visits to the institutions enthusiastically pointed out the many accomplishments and benefits derived from the computer. Frustration over the amount of state support of computing was voiced at all the institutions. Most of the computer facilities were found to have severe housing problems such as lack of space, fragmented space, exposed cables, poor air-conditioning and humidity control and poor housekeeping, especially in view of the sensitive equipment installed. The primary limitations on computer usage in most Kansas institutions are the shortage of funds, the need for more adequate space, and the inadequacy of equipment to handle administrative data-processing, education and research computing.

Other primary problems are the ones dealing with people: difficulty in obtaining, retaining and paying technical staff, orienting faculty and other staff to use the computer, and insufficient time and power for those units wishing to use the computer.

The kind of study reported here should be repeated periodically (perhaps on a less ambitious scale) because of the importance of keeping abreast of the rapidly changing computer technology and of determining how new developments will affect not only the institutions' computer plans and computer applications, but also inter-institutional plans and coordination. The computer field requires a long-range and continually updated plan.

On a few of the campus visits, the Committee members found themselves being asked questions rather than having them answered by those being interviewed. Both responses turned out to be equally valuable (hopefully to all concerned) because much was learned about what issues needed to be resolved from listening to the questions. The exchanges between the representatives of the institutions and the Computer Study Committee were most profitable because the former at last felt consoled that they were not alone in their troubles and that this study could lead to a solution of at least some of their problems. This type of exchange on a continuing basis would enable administrators, educators, Regents and Legislators to assess any given institution's development and lines of thought in the context of what her sister institutions have been able to do in similar situations.

The Conduct of the Study

The Committee decided to carry out its survey for the Regents in three stages:

(1) Questionnaire
(2) Campus visits and interviews
(3) Evaluation

The first phase is represented in the questionnaire and inventories found respectively in the Appendix and in the permanent files of the Committee. Because there was no previous information on record, each institution was asked to provide the Committee with a complete inventory of computing and data-processing equipment, a survey of current computer usage, a projection of needs for expansion of computing and data-processing facilities, and its point of view concerning the state-wide development of these facilities.

Since the questionnaire cannot answer all questions about the difficult and complicated computer problems arising from earlier computer acquisitions, from use patterns, from emerging needs, and from inadequate finance, much information for this study was gathered during campus visits and interviews. One-day visits were made at all seven of the institutions' computer facilities. While the Committee was on campus, interviews were conducted with three or four groups representative of the users in undergraduate education, research, library, and administration. Those interviewed were on the highest policy, administrative, and coordinating levels of their respective institutions. Interviews were conducted with about 120 persons--presidents, provosts, vice-presidents, and other administrative and academic officers, deans, librarians, instructors, and research investigators, as well as with computer technical personnel.

The third phase, evaluation, is covered in the recommendations section of the report. After the Committee identified the major problems that needed to be resolved, each member drafted major sections of the report. By allowing each member to formulate his own recommendations, opinions, and conclusions independently of the other members, the danger of presenting a biased report was kept to a minimum. Only after considerable discussion, rewording, rephrasing and rearranging did the group, as a whole, pull together the various independent studies and findings to present as objective a report as possible.

Numerous meetings of the Committee have been held since its organization and a great volume of material has been gathered, reviewed and studied. Members of the Committee have served without compensation for their services. Travel and other expenses have come out of each individual's departmental budget.

Time has been the critical factor limiting the extent of this study. In spite of the fact that all the members of the Committee have full-time appointments, the Committee has had some twenty meetings including visits to each of the seven campuses over the last nine months. In view of the time limitation, the Committee felt it important to present a summary of its recommendations in April in order to meet the deadline for institutional legislative requests for FY 1971. Nevertheless, the Committee felt that it would be inappropriate in view of the importance of its assignment not to present a full report. Therefore, the members of the Committee have devoted additional time to complete this report in its entirety.

Members of the Committee have worked diligently to provide the best possible recommendations to the Regents. Although substantially complete agreement was reached on most points, some of the recommendations were not unanimous.

The Committee would be gratified and feel that its labors have not been in vain if its recommendations provide the Board of Regents a positive plan to foster the development and continuation of a statewide coordinated program for computing in Kansas institutions of higher education.

Respectfully submitted,

Computer Study Committee:

Philip E. Arnold
Richard G. Hetherington
Theodore W. Hildebrandt
Russell Mills
John B. O'Loughlin

CONTENTS

Introduction and Recommendations 1

I. A Permanent Computer Advisory Committee 7

II. Funding and Accounting Procedures 10

Diverse Budget Practices 14

Funding Procedures 15

Problems of Paying for Computing Service 17

Accounting and Service-Clearing 23

Service Clearing 24

III. Computer Science Education. 28

The University of Kansas 31

Kansas State University. 31

Wichita State University 32

Kansas State Teachers College at Emporia 32

Fort Hays Kansas State College 33

Kansas State College at Pittsburg 34

K. U. Medical Center. 35

Vocational Education. 35

IV. Computer Hardware and Computer Network. 38

The Case for Administrative Computing Based on IBM 1401 System. 39

The Case for Centralization and Network Computing 40

Transition to Network Computing in Kansas Institutions of Higher Education 41

Summary 45

V. Review of Computing Center Space Facilities in Regents' Institutions 48

University of Kansas 52

Kansas State University 53

Kansas University Medical Center 54

Wichita State University 55

Kansas State Teachers College of Emporia. 56

Fort Hays Kansas State College 57

Kansas State College of Pittsburg 58

VI. Administrative Data-Bases and Data-Processing 60

Data-Bases for Institutional and Regents Reporting and Planning 60

Institutional Cooperation on Data-Processing Problems . . . 62

VII. Computer Center Staffing 65

Unclassified Personnel. 65

Classified Personnel 66

Appendix - Questionnaire Sent to All Regents' Institutions . . . 68

References 71

INTRODUCTION AND RECOMMENDATIONS

Few developments will have a greater impact on mankind than the development of the electronic computer. In slightly more than twenty years, the computer has had a profound effect on the world, and its effect during the next two decades will be even more profound. Dr. John R. Pierce, of Bell Laboratories, defined the present state of computer technology when he said: "After growing wildly for years, the field of computing now appears to be approaching its infancy."

The task of university and college administration today is one of unprecedented complexity. It cannot be made easy by the computer or any other mechanical device. The computer is not only an aid to administrators in decision making, but also provides a wide range of educational value to scholars and scientists. The computer is culturally and intellectually important in all higher education--not just in the obvious hard sciences and technologies. Specifically, computing technology is important because it is:

An aid to efficient and effective administration.

A professional tool in a growing number of fields.

An aid to research.

An object of research.

An aid to instruction and learning.

A model of the robots and automata which will increasingly affect society.

The invasion of computers into all areas of technology has placed a tremendous challenge before the colleges and universities of this state. It is the responsibility of the colleges and universities to insure that their graduates are prepared to meet today's technological challenges and that they are adaptable to meet tomorrow's challenges. This is a big responsibility. Unfortunately, most of the colleges and universities in Kansas, because of lack of resources, space and adequate equipment, are not able to meet this responsibility.

The purpose of this study was fourfold. First, the present inventory of computer equipment was to be determined. Second, the current use of existing computer equipment was to be surveyed and studied. Third, the adequacies and/or inadequacies of the present equipment inventories was to be evaluated. Fourth, comprehensive policy statements for the future role of computers in Kansas higher education were to be developed and recommended to the Board of Regents.

The recommendations of the Committee appear at appropriate points in the body of the report, and are listed below for convenient reference:

1. The Board of Regents should authorize its Executive Officer to establish a permanent, formally constituted, computer committee (advisory body) which is competent to aid in continuous planning and policy recommendations concerning administrative data-processing and computing in the institutions of higher education in Kansas. (Chapter I)

2. It is recommended that the Regents with the advice of this committee adopt a long-range plan for the development and use of computing in the Regents' institutions, and that any agency of the state government be urged to consult closely with the Regents' committee in the development of future state-wide plans. (I)

3. The Board should adopt as policy recurrent updating of long-range computing plans for each institution and for higher education as a whole. This updating process should occur at one-year intervals and produce two-year projections. (I)

4. The committee should provide technical review of requests for improved and added equipment at the computer centers of the various colleges and universities and advise the Regents whether approval is desirable from the point of view of economic and technical feasibility and from the point of view of educational desirability. In this activity the committee should cooperate with those state agencies having fiscal review authority. (I)

5. It is recommended that general revenue funding of computer costs be established for educational and general data-processing activities in all universities and colleges under the Regents' jurisdiction through a formula system. We further recommend that universities and colleges develop and use accounting procedures which accurately measure the cost and utilization of computer services. (II)

6. College and university computing centers serve an educational as well as a service function. They are admittedly expensive and require nearly continuous improvements in order to keep up with the increasing demands placed on them. Informed decisions regarding expansion and/or budgeting for current operations cannot be made without adequate cost and funding information. Various accounting methods are suitable for obtaining this information, but it is desirable to maintain uniform accounting procedures at all of the Regents' institutions.

The service clearing mode of operation is used in at least three of the centers, and the Budget Division is urging that it be applied to all the centers. The service clearing mode of operation provides the desired cost and budgeting information provided safeguards are set up to insure that (a) educational and other non-revenue producing activities of the computing centers are not neglected; (b) the computing center is made the sole supplier of computer service, supplies, and equipment to all other campus activities; (c) sufficient working capital is supplied to cover the regular billing period and any start-up costs because of the new mode of operation. (II)

7. It is recommended that six distinct levels of instruction be identified in the state supported colleges and universities:

   A. Computer Appreciation--providing a reasonable understanding of the properties and uses of computers for the average college-trained individual.

   B. Elementary Programming--teaching students the use of computers as a tool for key disciplines.

   C. Intermediate--providing the minimum prerequisites for future graduate work in computer science.

   D. Major Programs leading to the B.S. or B.A. in computer science.

   E. The Master's degree program.

   F. The Ph.D. program. (III)

8. The Committee further recommends that:

   A. All the Regents' institutions should, as a minimum provide instruction at the first three levels identified above.

   B. All of the universities and some of the colleges should eventually provide programs leading to the Bachelor's degree in computer science.

   C. All of the universities should provide graduate programs leading to the Master's degree in computer science.

   D. There should be one Ph.D. program in computer science in the State of Kansas. (III)

9. Computing facilities and staff adequate to the mission of the institution should be available to all Regents' institutions to support the preparation of students in all disciplines. (III)

10. Since secondary and vocational education are concerns of a distinct State agency (State Board of Education), it is recommended that the junior colleges, area vocational technical schools and those high schools which wish to participate, be given the responsibility for the two-year training of technicians and computer operators, while the colleges and universities educate professional systems analysts, programmers, and computer scientists. It is recommended that the colleges and universities not participate in the two-year vocational education programs. (III)

11. The existing IBM 1401 computer systems at the colleges are appropriate for their present administrative computing needs. The Committee recommends the colleges assure themselves that the 1401 facilities are adequately staffed and maintained to handle their administrative needs. Instructional and research computing needs may be met by augmenting these facilities with equipment which would provide conversational and/or remote batch access to larger facilities in the State or elsewhere. (IV)

    In order to investigate the cost and feasibility of such an approach, it is recommended that one college be selected to install such a terminal facility as a pilot project. (IV)

12. It is recommended that a telephone network be planned and installed to permit transmission of information between the several computing centers of the Regents' institutions. It is further recommended that a study be initiated leading to the establishment of a unified computer network linking these institutions. (IV)

13. Space for computing is a major problem at all institutions. Two institutions are presently suffering a loss of efficiency because of inadequate and fragmented space, while perhaps only one institution (Pittsburg) is adequately housed. Institutional planning for future building development must give high priority to space for computing. (V)

14. It is recommended that centralization of computer facilities be encouraged at all the institutions to provide adequate service for all users. Centralization of computing is desirable, both academically and administratively. (IV)

15. As the situation now exists, formulation of administrative data-bases and systems follows no particular patterns. It is recommended that the colleges and universities be required to develop and coordinate standard uniform guidelines and definitions of data-bases to facilitate the routine administrative functions such as registration, grade reporting, class scheduling, library circulation systems, accounting budget reporting, and other functions as they become apparent. Many tasks of a routine clerical nature are now being handled by the use of computers; but in addition to supplementing manpower with computing power (mechanization), many functions could be accomplished better by more

efficient methods utilizing the discoveries of both computer and management science to the greatest possible extent.

The introduction of the computer into the administrative operations of any organization requires a review of existing systems and a modernization of these systems in order to achieve the economies promised by automatic data-processing. (VI)

16. It is recommended that the institutions pool their resources and talents to develop uniform programs and systems for specific administrative applications such as registration, libraries, accounting and budget reporting. This may well be accomplished by designating each institution to assume primary responsibility for certain specific areas. (VI)

17. The computer field is expanding more rapidly than a rapidly expanding economy. Consequently, the colleges and universities particularly those in metropolitan areas, are finding it difficult to attract and retain qualified personnel, both classified and unclassified on their staffs. It is recommended that the Personnel Division of the State Department of Administration be encouraged to review and redefine the specifications and salaries for classified positions in the computer area, with a view to placing the colleges and universities, as well as all other State agencies, in a more satisfactory competitive position in the market for computer personnel. (VII)

CHAPTER I

A Permanent Computer Advisory Committee for the Board of Regents

As indicated in the introduction, the present Committee was established at the request of the Board of Regents because members of the Board felt that they needed to have expert advice on the development of computer centers and computer-related activities on the college and university campuses. Indeed, this is only one aspect of a general need for such advice felt by all elements of the State government. For example, several years ago the legislature established the post of Information Systems Specialist in the office of the Department of Administration (Senate Bill 317 of 1965). In another recent action, the Governor appointed a special committee to advise on the question of computers and communication systems in law enforcement. One impetus for the establishment of these and other bodies arises from the fact that the expense for computer service and personnel is becoming an ever larger portion of the total State budget. This is true as well of the college and university budgets.

Since they are not specifically excluded in Senate Bill 317 of 1965, and in other legislation relating to computers in the State government, the Regents' institutions come under the purview of the Information Systems Specialist in the Department of Administration. The effect of this legislation is that no changes or additions to the computing hardware at any of the institutions, no matter how trival, may be made without the prior approval of the Department of Administration. On the face of it, this seems like good policy and good procedure; however, in the operation the ideal is often not achieved.

What stands out most clearly is the fact that the environment of the university computing center, particularly that portion of it which is devoted to research and education, is quite different from that of the usual data-processing center in other State agencies. For example, the job mix at a data-processing center can usually be precisely scheduled and consists largely of long jobs with large amounts of input and output. The job mix in the educational and research computing center is random in its scheduling and emphasizes short jobs and rapidly changing programs; especially on the longer jobs, the ratio of input/output time to central processor time is far more modest than in the usual data-processing situation. It is because of these and similar factors that a distinction needs to be made between the educational and research computing activities, and the normal data-processing activities of the State. The rules which are applicable to data-processing must be subject to modification and flexible interpretation if they are to be applied at all to the educational and research computing center.

The Regents have already indicated that they feel the need for competent advice about computer development. The computer field is rapidly changing and the computer installations on the campuses must change at a similar pace in order to keep in step. Expenditures for computers have seemed to grow at an astronomical rate and the Regents need assurance that, even if these expenditures cannot be reduced, the money is well spent.

Computers and expenditures for computing have, as is pointed out above, been especially singled out for attention by other review bodies in the State, set up by legislative or administrative action. However, none of these presently constituted bodies has a particular concern for and knowledge about computing in the higher education environment.

The present Committee has been concerned about the need for assistance in the present State review procedures for new and expanded computer installations. This need has been evidenced by the slow response to requests and by some lack of understanding of the role of the computer in the educational milieu. It appears that one way to provide this assistance is for the Regents to establish their own review body which can operate on the basis of a long range plan, periodically updated, for the development of computers in the Regents' institutions. If this body can establish its responsibility and competence, it should reduce the need for full scale investigation of requests for computing equipment at other levels of the State government.

Therefore, it is quite appropriate that the Regents ask the Board's executive officer to establish a permanent Computer Advisory Committee. In order to be effective, this Committee should be relatively small. Both the colleges and the universities should be represented on the Committee by technically qualified people, and it would be well to have one or two equally well qualified individuals from the private sector. The executive officer of the Board of Regents or his designated representative might be ex-officio member of the Committee without a vote. The Committee should consist of from five to nine members plus the ex-officio member.

This Committee would be expected to accomplish several things.

1. To prepare for the Regents a long-range plan for the development and use of computing in the Regents' institutions.

2. To provide liaison between the Regents' institutions and other agencies of the State government which should be urged to consult closely with the Regents' Committee in the development of future State-wide plans.

3. To review at least annually the computer situation on the various campuses and to report to the Regents and the various colleges and university administrators. Such a report should be available for consultation by the college and university administrators when they are preparing their legislative budget requests for the following fiscal year.

4. To review proposals for educational programs in computer science at the Regents' institutions and to encourage the development of programs consistent with the defined role of the several institutions.

5. To review all requests for improved and added equipment at the computing centers at the various colleges and universities and to advise the Regents whether approval is desirable from the point of view of economic and technical feasibility and from the point of view of educational desirability. In this activity the Committee should cooperate with those State agencies having fiscal review authority. The Committee may determine that requests for equipment of less than a certain monthly rental or a certain purchase price do not require full Committee review, but may be reviewed and approved by the ex-officio member.

Recommendation 1: The Board of Regents should authorize its Executive Officer to establish a permanent, formally constituted, computer committee (advisory body) which is competent to aid in continuous planning and policy recommendations concerning administrative data-processing and computing in the institutions of higher education in Kansas.

Recommendation 2: It is recommended that the Regents with the advice of this committee adopt a long-range plan for the development and use of computing in the Regents' institutions, and that any agency of the state government be urged to consult closely with the Regents' committee in the development of future state-wide plans.

Recommendation 3: The Board should adopt as policy recurrent updating of long range computing plans for each institution and for higher education as whole. This updating process should occur at one-year intervals and produce two-year projections.

Recommendation 4: The committee should provide technical review of requests for improved and added equipment at the computer centers of the various colleges and universities and advise the Regents whether approval is desirable from the point of view of economic and technical feasibility and from the point of view of educational desirability. In this activity the committee should cooperate with those state agencies having fiscal review authority.

CHAPTER II

Funding and Accounting Procedures

The development of computing centers at the State colleges and universities of Kansas has followed lines quite similar to those at a great many institutions throughout the nation. Equipment funding has been found in the other operating expense budget of the institution, often supplemented by Federal grants; the salaries of director and other professional personnel have been funded from the resident instruction budget. The programming staff has been drawn largely from undergraduate and graduate student assistants, and the few classified people required have been converted from classified positions in other areas of the institution. In the absence of sponsored research projects, the entire computer operation has been supported from State funds.

As long as the funds required for the support of a computing activity were negligible in comparison with the remainder of the institution's budget, there appeared to be no need to investigate the sources of these funds and to account for their expenditure. However, computing activities, not only in educational institutions throughout the nation, but in business and government as well, have a tendency to grow at an exponential rate (the normal growth curve of any organism). In particular, the growth of the computing activity appears to be at a much greater rate than that of any other activity on the campus. Consequently, the expenditures for computing have become a significant fraction of the total budget of each of the institutions. It is at this point that one may say the computer has truly taken hold in the institution. And, it is at this point that the institution must ask for additional funds to maintain and expand the computing activity at levels considered necessary by its administration, faculty and students. It is at this point too that the Regents quite rightly ask "How much is this computing activity costing us now? How much is it likely to cost in the future?"

The attached schedule, Table 1, was compiled from annual budgets for fiscal year 1968, and from budget requests for fiscal year 1969, supplemented to some extent by other estimates received from the institutions themselves. Even the compilation of these data has not been an easy task because funding of institutional computing activities has not been shown as a separate item in any of the institutions' budgets. (This has been due, of course, to the way in which these activities were initially funded and to the tendency to continue the same funding patterns as the activities grow.)

In examining these figures one must, of course, bear in mind all the usual factors which distinguish the institutions one from another:

- The assigned mission of the institution.
- The local aims and desires of the institution.
- The sources of funding outside the usual State appropriations. (Federal funds and State funds from non-Regents sources.)
- The number of students and the ratio of graduate students to undergraduates.
- The research orientation of the institution.
- The size of the faculty.

Computer hardware may be acquired by the institution through one of several plans:

1. By lease.
2. By outright purchase.
3. By means of a lease-purchase plan, under which clear title to the hardware is eventually acquired through periodic payments.

Most of the institutions have chosen the lease plan as being the most economical, because of the high rate of obsolescence which is characteristic of the computer industry today. (The efficiency of computing hardware has improved so rapidly as measured in computations per dollar that equipment becomes uneconomical, hence obsolete, within five years of installation.) Thus, rental of equipment becomes one major fixed cost in the operation of a computing center.

Most of the personnel costs are also more or less fixed. The only personnel costs which are directly related to the usage of the center are those for operating personnel and even these tend to jump in a discontinuous fashion as additional hours of operation become necessary. Materials costs, on the other hand, are much more closely related to the usage of the center. These include principally the cost for cards and printer paper, and, in most centers, magnetic tapes and disks.

From the above, it is obvious that the cost of the computer hardware does not represent the total cost of the operation. Computer personnel should cost at least as much as hardware. A generally accepted rule of thumb is that equipment should account for significantly less than half of the cost of the total operation. It is apparent from the budget figures given above that the only institution meeting this criterion

TABLE I

COMPUTER COSTS DERIVED FROM ANNUAL BUDGETS AND ESTIMATIONS

		Fiscal Year 1968			Fiscal Year 1969		
	Cost Center	Salaries & Wages	O.O.E.	Total	Salaries & Wages	O.O.E.	Total
University of Kansas							
Data-Processing Center	General Expense	$130,440	$120,000	$250,440			
Computer Center	Organized Research	322,344	400,000	722,344			
Computation Center	Service Clearing				$491,194	$659,000	$1,150,194
TOTAL		$452,784	$520,000	$972,784	$491,194	$659,000	$1,150,194
Kansas State University							
Administrative Data-Processing Center	General Expense	$ 65,949	$ 65,363	$131,312	$130,109	$ 70,600	$ 200,709
Computer Center	Organized Research	12,585	28,311	40,896	17,511	37,313	54,824
Computer Center	Resident Instruction	169,187	305,971	475,158	193,226	248,268	441,494
Library (Estimated)	Library	18,898	25,000	43,898	20,000	25,000	45,000
TOTAL		$266,619	$424,645	$691,264	$360,846	$381,181	$ 742,027
Wichita State University							
Digital Computer Center	Service Clearing	$ 77,265	$ 80,242	$157,507	$125,486	$112,929	$ 238,415
K.S.T.C., Emporia							
Data-Processing Center-Administrative	General Expense	$ 23,208	$ 1,005	$ 24,213	$ 27,179	$ 6,825	$ 34,004
Business and Business Education Department	Resident Instruction	23,901	58,557	82,458	29,895	64,275	94,170
Librarianship	Resident Instruction	13,670	-	13,670	17,397	-	17,397
Library Services	Library	3,000	9,000	12,000	8,440	14,870	23,310
Bureau of Educational Measurements	Auxiliary	5,022	6,727	11,749	11,506	6,966	18,472
TOTAL		$ 68,801	$ 75,289	$144,090	$ 94,417	$ 92,936	$ 187,353

	Cost Center	Fiscal Year 1968			Fiscal Year 1969		
		Salaries & Wages	O.O.E.	Total	Salaries & Wages	O.O.E.	Total
K.S.C., Pittsburg							
Tabulating Department	General Expense	$ 17,791	$ 11,068	$ 28,859	$ 18,770	$ 10,780	$ 29,550
Business Administration	Resident Instruction	30,728	30,650	61,378	33,005	30,700	63,705
Related Activities	Resident Instruction	-	14,600	14,600	-	14,600	14,600
TOTAL		$ 48,519	$ 56,318	$ 104,837	$ 51,775	$ 56,080	$ 107,855
Fort Hays Kansas State College							
Data-Processing	General Expense	$ 18,519	$ 49,417	$ 67,936	$ 22,071	$ 51,000	$ 73,071
Economics and Business (Estimated)	Resident Instruction	19,106	4,000	23,106	19,298	5,000	24,298
TOTAL		$ 37,625	$ 53,417	$ 91,042	$ 41,369	$ 56,000	$ 97,369
University of Kansas Medical Center							
Computer Services	Service Clearing	$ 218,700	$ 130,200	$ 348,900	$ 256,250	$ 171,000	$ 427,250
Computation Center	Organized Research	44,400	61,200	105,600	44,400	61,200	105,600
TOTAL		$ 263,100	$ 191,400	$ 454,500	$ 300,650	$ 232,200	$ 532,850
GRAND TOTAL		$1,214,713	$1,401,311	$2,616,024	$1,465,737	$1,590,326	$3,056,063

is the KU Medical Center. We must conclude that the college and university computer centers are understaffed, probably for lack of sufficient funds.

Finally one need hardly point out that there is the further overhead cost of space, heat, light and power, and janitor service, which is generally not reported separately for the computer center.

Diverse Budget Practices

Because the initial support for the computing centers in colleges and universities was often patched together from a number of different budgetary sources, the bewildered observer trying to determine computing costs from the budgets of the institutions often feels that the institutions have deliberately hidden the information which exhibits the extent of their data-processing and computer operations. Since these are now recognized as proper activities on the campuses, it is appropriate that budget figures for personnel and operating expenses for computing and data processing be gathered together for ready review and appropriate support.

One frequent abuse in the budgeting area is the practice of putting the salaries of computing center managers and other personnel in departmental teaching budgets. One institution with a powerful and expensive computer has an incredibly meager budget for its computer center since most of its personnel budget is paid out of the resident instruction cost center. At this institution, the total actual cost of computation may be three to four times as great as what is reported in the computing center's budget.

At the colleges, the support of the computing center generally comes from internal sources:

1. From the administrative activities of the college.
2. From the resident instruction budget.
3. From the library budget, since the computing center is used by library personnel in cataloging and circulation control.

The accounting arrangements of the various computing centers cause much of the confusion concerning costs and eventually the diverse budget practices. All expenditures for "tabulating" and data-processing operations were to be charged to the General Expense Activity in accordance with the uniform accounting practices approved by the Board five years ago. This was before the unprecedented development of the computer in the educational process and research activities. Now computer operations can be found at some institutions in a number of activities where they exclusively serve that function only (such as instruction, research, library). In some instances, because data-processing and computing serve several different functions within the institution, a separate service department (Service Clearing) has been created for accounting purposes (on a revolving fund basis). Under this scheme, other operating expense funds are allocated to the various departments and divisions which then pay with these funds for services rendered by the computer center.

In other instances when computing expenditures are considered a General Expense to the institution, computer service or use is allocated by the Director or Administrator of the computer center. This arrangement works quite well at some institutions, providing the center functions as a service organization and a priority system is agreed upon. No charges are billed for any service that is provided internally. The federal research and outside or industrial services are billed and the receipts are used to provide more resources at the computer center.

Funding Procedures

The present state of the computing facilities in the Regents' institutions has been made possible by substantial educational allowances or discounts by the vendors (in the case of the obsolescent 1401's, as much as 60%); by substantial grants from the Federal Government; and by partial donations from State agencies (e.g. the impending transfer of the lease-purchase contract for an IBM 360 Model 30 from the Accounts and Reports Section from the State Controller's Office to Kansas State University). In the support figures which follow, the educational allowances by the vendors do not appear explicitly. Instead the expenditures for equipment rental or purchase shown include the deduction for the educational allowance.

Five major sources of funds finance computing in Kansas higher education. These funds and their approximate percentage of contributions to expenses are shown below.

General-Use Funds	49.4%
Research Overhead Funds	20.3%
Restricted Fees	27.9%
State Board of Vocational Education	2.0%
Bureau of Educational Measurements	.4%

It can be observed that less than half of the support for the cost of computing is absorbed by the State appropriations and fees. The larger portion comes from research funds of several government agencies and the overhead derived from research grants. NSF, ARPA, NIH, and AEC have all recognized the need for modern computing even though they can provide only modest support and only for growth and upgrading the equipment. It should be kept in mind that this money is "soft" in the sense that it can be withdrawn at any time.

Computing needs on the campus grow faster than any other need and, in order to keep up with the need, computing expenditures, in turn, grow faster than other comparable expenditures. Therefore, it is not surprising that the most advanced institution, with one of the most sophisticated computing services, was the hardest pressed for funds. The colleges seem to be less hard pressed for computing funds, but their computer development has been going on for a smaller number of years.

In order to plan for the financing of the growth of the computing enterprise, it is desirable to estimate the approximate rate of growth. Making this estimate is difficult for a number of reasons. Of course, the one outstanding reason is the great improvements in computer efficiency which have been achieved over the past five to ten years. These improvements have resulted in vastly more computing for the dollar expended. However, the computer users have found new and more complicated uses as the machines have become more efficient. Therefore, precise estimates of the rate of growth of computing expenditures based on precise knowledge of computer developments are virtually impossible.

Probably the most realistic estimate of the rate of growth of computing expenditures is that based on experience not only in the State of Kansas but throughout the United States. Annual growth rates as high as 45% per year--almost doubling in two years--are given in the Rosser report. The average annual growth rate for all the Kansas institutions between 1968 and fiscal year 1969 is 17%. This is obviously considerably larger than the average growth rate of all institutional expenditures. While the 45% mentioned in the Rosser report is an extreme, an average growth rate of 25% to 30% is not at all unusual.

The following schedule indicates the projected annual expenditures for computer costs by the institutions in two years and in five years. These figures have been developed from the institutional responses to the Committee's questionnaire. The approximate average annual rate of growth corresponding to these figures is shown in a parallel column. It is to be noted that in some cases the two-year projection departs widely from that which would be expected on the basis of the average annual rate of increase mentioned here. In particular, the proposed average rate for the University of Kansas over the first two years is approximately 61% and the rate for the next three years is a more modest 31 1/2%.

	FY 1971 Annual Budget	FY 1974 Annual Budget	Average Yearly Increase
University of Kansas	$ 3,000,000	$ 7,000,000	43.5%
Kansas State University	1,113,000	2,226,000	25.0%
Wichita State University	490,000	1,000,000	33,3%
K.S.T.C., Emporia	227,000	302,000	10%
K.S.C., Pittsburg	130,000	174,000	10%
Fort Hays K.S.C.	118,000	157,000	10%
KU Medical Center	720,000	1,380,000	21%

It should be emphasized again that these projections are based on each institution's own views of its needs. In publishing these figures, the Committee does not necessarily approve of them. In fact, the majority of the Committee doubt that there can be adequate justification for any single institution to show a rate of growth of computer expenditures two to six times that of any of the others. The Committee suggests that the benefits to the State may be greater if a more uniform rate of growth is achieved by all of the institutions--at a rate significantly larger than that currently shown for the colleges and significantly smaller than that shown for the University of Kansas. Nevertheless, the Committee reiterates its warning that the expenditures for computing must rise at a rate greater than that for other expenditures for higher education. At the same time, we realize that this raises the serious question of where the financial resources will be found to support this growth.

Problems of Paying for Computing Service

It appears reasonable to ask whether by use of the computer the colleges and universities can reduce their administrative and other costs sufficiently to fund the computer installation: They cannot. Indeed, it is not at all clear that the use of the computer may result in actual dollar savings in administrative costs. For as administrators and faculty learn the abilities of the computer, they make ever greater demands for reports and service from the computer. Since the individual administrator will be getting more information, better information and faster information than ever before, cost comparisions would be meaningless. At the same time, computerization of administrative procedures almost inevitably leads to modernization of antiquated procedures, redesign of methods and an increase in the total work done.

It is more useful to speak of the values and benefits of a computerized system rather than of superficial savings. In such a presentation the following points may be made:

1. More effective planning and better use of fixed resources can be achieved with better information.

2. With expanding enrollment and/or research programs, costs do not go up proportionally with volume.

3. Cost of living indices constantly force salaries and wages upward, while hardware costs remain relatively stable or go down.

One last point: It is difficult to place a precise dollar value on significantly improved quality of information, services, planning and education.

Funded research activities which use the computer can be expected to pay for some part of the cost of operating the machines, but no more than a fair share. In the case of federal contracts, their share is precisely determined by Federal laws; as mentioned earlier, federal funding is leveling off. But, the long-range commitments and relatively fixed income components of our Kansas higher education institutions simply do not allow rapid reduction of existing programs nor rapid generation of substantial new sources of income.

If the computer is recognized as an integral part of the educational program of all the institutions, it is clear that it must be supported as is any other regular operating expense of the universities and colleges. A reasonable approach to this necessity is a formula system for state support, similar to those used in other areas in the current budget process. The formula developed would have to provide for a base amount which would allow the smaller institution to maintain a modest computing capability. At the same time, a formula must provide for the growth of newly established installations and promote the continued achievement of those centers which presently have well-developed computer facilities. Careful consideration must be given to the relation of these requirements to the weighing of the various data upon which the formula is based.

Computing is such an integral part of the educational process that support for educational use by students of various categories should be budgeted from General-Use Funds just as is support for the library. Similarly adequate administrative data processing is absolutely necessary for the efficient operation of the business and educational functions of a university or college.

The proper level of basic support for computer operations is a matter of much discussion across the nation. One approach in Kansas is to analyze the present costs of computing of various types in the two institutions (K.U. and K. State) which have the most developed educational uses of computers.

Each institution has responded to tremendous pressures from the educational programs by investing all available resources to develop their computer centers. This investment is fast depleting these sources other than General-Use Funds, so that this level of expenditure cannot be maintained much longer without basic operating fund support of the educational and administrative computing.

Yet even these heroic efforts to fund the educational computing needs of the institutions are barely keeping pace with the increased demand for access to a computer in many educational programs (access which is essential in modern university and college education). Use of the computer as a professional tool in a growing list of fields such as physics, chemistry, biological science, mathematics, engineering, business, and even the humanities requires that this usage be a part of the higher education resource in these fields. The usage increases impressively at higher levels of education; doctoral research is tremendously demanding.

The University of Kansas and Kansas State University are the only Regents' institutions which have records which allow analysis of computer usage (and therefore costs) for various functions. Estimated expenditures in FY 1969 for these functions, based on percentages obtained by analysis of FY 1968, are as follows:

	K.U.	K. State
1. Administrative & Library	$ 291,000	$224,000
2. Classes and Undergraduate Research	126,000	90,000
3. Graduate Research	330,000	170,000
4. Faculty Research (sponsored & unsponsored)	392,000	190,000
	$1,139,000	$674,000

These various functions will be discussed separately.

1. Administrative data processing (financial, student, faculty, registration and enrollment, etc.) and library usage are logically more closely related to student head count than to any other factor. Analysis of cost per student enrolled yields (based on Fall 1969 head count).

   K.U. $291,000 ÷ 16,482 = $17.66/head/year.
   K.S.U. $224,000 ÷ 12,570 = $17.82/head/year.

   It is logical that this kind of usage should be entirely supported by the basic budget of the institution.

2. Class Teaching of Computer Science and Undergraduate Research

   It is assumed that these activities are directly related to credit hour enrollments, and that almost all class teaching is at the undergraduate level.

   The data available for analysis are:

	K.U.	K. State
Cost, FY 1969	$126,000	$ 90,000
FY 1969 Lower Division Credit Hours	200,972	186,670
FY 1969 Upper Division Credit Hours	218,499	133,875

   Solving simultaneous equations, the costs per credit hour are about $0.194 for lower level and $0.40 for upper level. It is logical again that these costs clearly should be a part of the basic operating budget of the University.

3. Graduate Research (by students)

   The data available are:

	K.U.	K. State
Cost, FY 1969	$330,000	$170,000
FY 1969 Master's level Credit Hours	41,737	37,324
FY 1969 Doctoral Credit Hours	21,005	8,433

It is obvious by inspection that the major difference in cost can be associated with doctoral credit hours (mostly doctoral theses). Again, solving simultaneous equations, the costs per credit hour are about $1.87 at the Master's and $12.00 at the Doctoral level. Again, these are clearly educational costs and should be part of the basic operating budget.

It should be noted that the ratios of costs of the various levels of educational computing, per credit hour, are (excluding Faculty Research, #4):

Lower Level Undergraduate	1.00
Upper Level Undergraduate	2.06
Master's level	9.64
Doctoral level	61.08

4. Faculty Research (sponsored and non-sponsored)

A basic assumption is made that the level of faculty involvement in research will be related directly to the mix of masters and doctoral level graduate enrollments.

The basic data are:

	K.U.	K. State
Cost, FY 1969	$392,000	$190,000
FY 1969 Master's Credit Hours	41,737	37,324
FY 1969 Doctoral Credit Hours	21,005	8,433

Solving simultaneous equations, the master's credit hours cost about $1.65 and the doctoral $15.40 each.

The computer is a basic tool for graduate faculty, who must be provided at least some research tools by the University as part of their employment.

Hence, the assumption is made that half the cost of computing for faculty research should be supplied by the institution, and half should be obtained by sponsored research, if the faculty member desires to do more extensive research than the institution can itself support.

Therefore, it is assumed that the amount of support needed to be supplied by the basic operating budget is $0.82 per master's credit hour and $7.70 per doctoral credit hour.

Adding these components together, and rounding, the estimated needs for basic operational support for computing, from General-Use Fund, should be:

Per Student	$18.00
Per Lower Division Credit Hour	0.20
Per Upper Division Credit Hour	0.40
Per Master's Level Credit Hour $1.90 (#3) plus $0.80 (#4)	2.70
Per Doctoral Credit Hour $12.00 (#3) plus $8.00 (#4)	20.00

Calculations of the amounts needed, by these values, for each State institution (excluding KUMC) are on the next page. (KUMC should also have such a budget component for education, on the same formula.)

Calculations are based on Board of Regents' data, December 19, 1968.

(The weighing factors, per credit hour, for the above figures are:

Lower Division	1
Upper Division	2
Master's Level	13.5
Doctoral Level	100

These are quite different, to say the least, from the weighing factors for new faculty positions.)

From these figures (on the next page) we develop the following:

	For FY 1969		
	Formula Requirement for Basic Funding	Actual General-Use Funds Available	Increment Needed
K.U.	$957,460	$428,087	$529,373
K.S.U.	612,119	267,940	344,179
W.S.U.	342,240	219,945	122,817
Emporia	263,240	148,881	114,359
Pittsburg	194,026	68,417	125,609
Hays	179,504	76,129	103,375

It should be noted that the level of computing at W.S.U. is about 2/3 of that indicated by the formula; at Emporia, Pittsburg and Hays, it is about 1/2. This agrees with observations that use the computer data processing and class teaching at these institutions is below that at K.U. and K.S.U., for comparable activities. These functions need to be developed. Most of the operating budgets of these operations already come from General-Use Funds. More State funds are needed to allow increased activity. The relation of this increased activity to a computer network, and major computers, is discussed elsewhere in this report.

At K.U. and K.S.U., on the other hand, most of the educational computing and data-processing are funded by funds other than General-Use Funds already--a very unhealthy situation. This financing of basic educational functions by outside, non-stable and non-recurring funds, is the reverse of what the picture should be. The "frills" should be provided by outside support; the basic support must be provided by the sustaining budget, like the library.

For:	K.U.	K.S.U.	W.S.U.	Emporia	Pittsburg	Hays
Lower Division	$ 40,194	$ 37,334	$ 25,607	$ 18,680	$ 12,807	$ 15,011
Upper Division	87,400	53,550	45,328	37,030	33,778	27,508
Masters	113,090	100,775	61,903	80,306	40,989	38,723
Doctoral	420,100	194,200	60	-	-	-
Headcount - Administration	296,676	226,260	207,864	127,224	106,452	98,262
Total - Basic General Use Funding	957,460	612,119	342,762	263,240	194,026	179,500
Add 1/2 of Faculty Research (Sponsored) (as in #4)	196,000	95,540	18,800	24,389	12,448	11,760
Total Estimated Computer Budget, by Formula	1,153,460	707,659	361,562	287,629	206,474	191,264
Total Actual Computer Budget FY 1969	1,150,194	665,762	238,415	187,353	107,855	84,405

The figures so far presented do not allow any further expansion of computer usage in educational efforts. As a conservative estimate the costs should increase at least 15% per year for the next few years.

Accounting and Service-Clearing

There are at least three possible modes of operation of the computing center on the college campus.

1. It may be treated as a completely overhead item similar to the library. By this mode of operation the services of the computing center are available free to all personnel on the campus whether in administrative offices, faculty positions or students. In its purest form no attempt is made to limit the service to any class of customers and the load on the computing center may rapidly reach saturation with respect to the budget of the center. It is to be noted that in this mode of operation no attempt is made to collect direct charges for computing service, even from sponsored projects. Evidently, the sponsored project's contribution to the maintenance of the computing center would be through sponsored research overhead. The attraction of this method may be limited to those institutions in which sponsored research is a very small item.

2. The computing center is treated as a free resource for all unsponsored student and faculty and administrative users. But, sponsored projects are expected to pay for the computer time used on a "quid-pro-quo" basis. If any of these sponsored projects are supported by the Federal Government, Government regulations require the center to maintain complete records of all usage, for the Federal Government will not pay more for the service than the lowest rate available to any user.

3. Direct charges to all users for the computer time used. In its purest form the computing facility receives no direct support from State-appropriated funds and must depend on its billing for all of the support of the activity. In the State of Kansas, university-related activities which make direct charges to departments or individuals using their services are known as service-clearing activities.

Some of the computing centers studied, namely those at the colleges, are operated in mode (1) the pure overhead mode. Kansas State University and until recently the University of Kansas computing centers have been operated in mode (2), the mixed mode. The centers at Wichita State University and Kansas University Medical Center have been operating in mode (3), the service-clearing mode, for some time.

The Regents' institutions are being pressed, particularly by some of the members of the Budget Director's staff, to place all their computing operations on a service-clearing basis. The expressed reason is that this would require the computing centers to maintain accurate records of all computer usage and would be helpful in accounting for and projecting the expenditures for computing. It should be apparent, however, that mode (2) makes nearly as stringent requirements on record keeping as mode (3) and that the State need merely require suitable reports in order to get the same kind of information from the mode (2) operation as from a mode (3) operation. The following is a discussion of the advantages and disadvantages of operating computing centers on a service-clearing basis.

Service Clearing

1. Placing computing facilities on service-clearing would work somewhat as follows:

   In preparing budget requests, each department and college would include an amount budgeted for computer service. The aggregate requested by the institution would be sufficient to support, and expand as necessary, the total computing activities of the institution for the budget year. After the budgeting and appropriation procedure has been completed, each college and department would be allocated funds to be expended on computing in proportion to its request. In the most elementary interpretation of the procedure, these funds would be transferred to the computing center as payment after the fact for computing service.

   Some of the disadvantages are obvious; other are more subtle:

   A. Possible failure to meet minimum support level for the computing center. Most of the expenses of computing center operations are fixed--machine rental and salaries--unresponsive to short time changes in the level of use of its facilities. Expenses for operating supplies, which are a relatively minor part of the total, are roughly proportional to usage, and operating staff may vary by quantum jumps as usage changes. But a certain minimum level of support is required to maintain the facility in an operable condition, regardless of the level of use.

      The danger is two-fold. First, unless computing funds in college or departmental budgets are restricted and ear-marked for expenditure only in the university's established computing facilities, they may be spent off-campus for service or for equipment to establish additional college computing centers. Second, even if the funds are ear-marked, deans and chairmen may be reluctant to authorize their use early in the academic year pending more interesting projects and demands. As a consequence, the income of the computing center may turn out to be insufficient to meet its fixed expenses in some months, or years, even though sufficient moneys have been appropriated.

There is a method of operation possible, and hopefully legal, which would obviate this objection. We shall discuss it later.

B. Somewhat more subtly, we fear that placing the center on service-clearing would adversely affect the philosophy of the center's role on the campus.

When a center is financed at least in part from the resident instruction component of the institution's appropriations, it seems natural that it should indulge in training, consultation, research and development activities. We submit that these activities are a necessary and important part of the contribution of the computing center to the rest of the institution and should not under any circumstances be abandoned. In the service-clearing environment, on the other hand, these activities are not directly revenue-producing. The question then is whether the customers of a service-clearing center would be willing to pay sufficiently high rates for service to permit these non-revenue-producing activities to be supported as necessary overhead expenses.

C. A totally opposite philosophy of university computer centers is that they should be like libraries--totally supported by appropriated and sponsored-research overhead funds, and available to all potential users on a free basis. This is an attractive point of view, and is certainly reasonable when one considers that the computer has become for many disciplines as essential an educational and research tool as the library has traditionally been. On the other hand, since the service offered by the computing center is of a kind different from the service offered by the library, different controls are needed to insure that all patrons receive their fair share of the service (since, in a practical situation the computer center, like the library, deals with a limited resource). Until now, no one has suggested any more practical method of allocating the computing resource than the economic one--whether in terms of real dollars or in terms of simulated dollars ("play money" or "brownie points") or their equivalent in computer time.

On the other hand, some advantages are apparent:

A. Simplified billing and collection procedure: Fund transfers could be made to the service-clearing fund locally through the use of transfer checks, instead of the current method (for transfers to computing center restricted fees account) requiring processing of vouchers and issuing of warrants in Topeka.

B. More flexibility in computing center management. As a service-clearing activity, staffing of the computing center would no longer be subject, even in part, to the restrictions on staffing inherent in the present enrollment based formula, since it would not receive direct support from general revenue funds.

C. As previously indicated, the management of a center operated in mode (2) must play an active role in determining a fair allocation of the available unsponsored computer time to the various colleges and activities of the university. The introduction of mode (3) (service-clearing) makes this allocation a part of the normal budgeting procedures and reduces the role of the management of the computing center in this activity.

D. Placing more burden on deans, department chairmen, and faculty to insure that the computer resource is used in an economical fashion. At the same time, the necessity for improved economies of operation is made clear to the computing center management and staff.

E. Within reasonable limits, service rates can be set to provide for the build up of a balance in the service-clearing fund as a basis for future hardware expansion to handle increased and changing demands for service.

2. A possible practical method of computing center operation under service-clearing.

It would be practicable to operate the computing center as service-clearing provided all of the following conditions are fulfilled:

A. The budget for computing services in the institution must be the larger of the following figures:

i. The anticipated expense of operation of the computing facilities during the year.

ii. The total estimated computer usage (measured in dollars) for the entire campus during the year, increased by a discretionary amount to cover contingencies.

B. The computing facilities must have guaranteed income from the colleges and other units of the university to cover a reasonable minimum level of operation. This can best be accomplished by assessing each college and other unit planning to use the services of the facility a share of this minimum expense, to be paid as a retainer into the funds of the computing facility at the beginning of the year. The amount assessed should be significantly less than the total amount appropriated to each college, and could be returned to the college as prepaid computer service for some classes of users.

C. The computing facilities must have the same favored sole supplier position as other service-clearing activities on the campus, so that funds appropriated for computer service will be expended through these facilities.

D. A portion of the funds appropriated for computer services should be held in reserve as a contingency fund, administered by a standing committee of faculty and administration, to provide for new and exceptional projects which cannot be covered by funds already appropriated to the colleges.

E. The computing facility must be permitted to fix rates which will be sufficient to cover overhead and non-revenue services required by its position and patrons or it must receive direct general revenue support for these services.

F. The rates charged by a service-clearing facility should be sufficient to cover contingencies in the operation as well as maintenance, replacement and moderate expansion of its equipment.

Recommendation 5: It is recommended that general revenue funding of computer costs be established for educational and general data-processing activities in all universities and colleges under the Regents' jurisdiction through a formula system. We further recommend that universities and colleges develop and use accounting procedures which accurately measure the cost and utilization of computer services.

Recommendation 6: College and university computing centers serve an educational as well as a service function. They are admittedly expensive and require nearly continuous improvements in order to keep up with the increasing demands placed on them. Informed decisions regarding expansion and/or budgeting for current operations cannot be made without adequate cost and funding information. Various accounting methods are suitable for obtaining this information, but it is desirable to maintain uniform accounting procedures at all of the Regents' institutions.

The service clearing mode of operation is used in at least three of the centers, and the Budget Division is urging that it be applied to all the centers. The service clearing mode of operation provides the desired cost and budgeting information provided safeguards are set up to insure that (a) educational and other non-revenue producing activities of the computing centers are not neglected; (b) the computing center is made the sole supplier of computer service, supplies, and equipment to all other campus activities; (c) sufficient working capital is supplied to cover the regular billing period and any start-up costs because of the new mode of operation.

CHAPTER III

Computer Science Education

There are two principal reasons for maintaining a computing center on a university or college campus. One is to provide for the regular day-to-day administrative processing for the institution. The other is to provide laboratory facilities for students who are expecting to enter a computer related profession and for graduate student and faculty research. In considering the adequacy of the computer installations in the colleges and universities under the Board of Regents, we must also evaluate the present situation with regard to computer education programs and their future growth. The aims of computer education are at least fourfold:

1. *To provide a reasonable sophistication for the average college-trained individual in the properties and possibilities of computers*.

   The development of the modern electronic digital computer less than 20 years ago has been likened by many to the development of the steam engine by Watt; and the effect of the computer upon our civilization is likely to be as far-reaching as that of the steam engine was on the civilization of the early nineteenth century. In other words, we are now embarked upon a computer revolution which is analogous to the industrial revolution of the nineteenth century. As such, it behooves all educated people to have an understanding of the computer and its potential influence on modern life. Therefore, courses in computer appreciation or introductory computer programming should be available to *all* college level students. One might even argue that such an introductory course should be *required* of all students.

   Authorities on computer education are not in complete agreement on the content of this introductory course. Some believe that it is possible to give the student an appreciation of the computer without actually teaching the student to program the computer. Others feel that at least a rudimentary introduction to programming is an absolute necessity if the student is truly to have an understanding of the properties of the machine--particularly of the fact that the limitations of the machine and the errors committed by the machine can generally be traced ultimately to the limitations and errors of the human programmer or operator.

2. Teaching the use of the computer as a tool.

Many students in engineering, scientific, technical, business and behavioral areas will need to have sufficient knowledge of the computer so that they can use it as a tool in their future professional employment. More and more employers today are expecting graduates to be able to communicate sensibly with and about computers. In addition, the applications of computers in research are now so pervasive that graduate students not only in scientific and technical fields but also in the arts and the humanities may expect to use the assistance of the computer in their research.

This minimum level of communication can best be achieved in a course on computer programming of at least one term duration. Programming the computer is a much higher level of intellectual activity than operating a desk calculator, adding machine or slide rule. While eventually computers may indeed become self-instructors, at the present time there is no substitute for a course of at least three semester hours in training students to use the computer as a tool. Indeed, the technically inclined often find that additional training is desirable to help them use the computer in more precise and professional ways.

3. The training of computer professionals.

There is a continuing and growing demand for professional programmers in a great many areas of interest. While there is no specific agreement on the level of education of the programmer, most employers today expect the programmer to have a college degree. Most entering students know this, and many are ready to embark on a college career leading to a degree in computer science, which they hope will open doors for them when they seek employment. It is as reasonable today to train graduates in computer science as it is to train graduates in home economics, engineering, education, or agriculture. The State colleges and universities of Kansas are attempting to meet this demand. But probably all of them are failing in some measure to provide satisfactory programs. We will discuss the specific characteristics of these programs in the succeeding sections.

4. At the graduate level.

Master's programs in computer science, as in other disciplines, are designed for two purposes:

a. As terminal programs

b. As preliminary to the Ph.D. program

In most cases, the terminal and pre-Ph.D. programs are parallel over a great portion of the subject matter. However, the terminal Master's program is designed to produce systems analysts and supervisors of programming effort, as well as vocational and college teachers in computer science. The Ph.D. programs, on the other hand, are designed to produce leaders in the computing profession--researchers, theoreticians, university faculty--those who are expected to extend the abilities of the computer and to overcome its limitations. As yet, none of the State universities has a Ph.D. program in computer science, but such a program is urgently needed.

The various levels of computer science instruction can be divided as follows:

1. Computer appreciation.
2. The tool use of computers, i.e., elementary programming.
3. The minimum prerequisites for graduate work in computer science.
4. A major leading to a B.S. or a B.A. in computer science.
5. A Master of Science program.
6. Ph.D. program.

Which of these programs are appropriate for which institutions in the Regents' system?

In the absence of a complete master plan for the development of the Regents' institutions, the Committee recommends the following:

A. All of the Regents' institutions should, as a minimum, provide instruction in the first three categories.

   1. They should provide computer appreciation courses for the broadest spectrum of students. (Eventually we foresee that such a course may be required of all students at the college level.)
   2. They should provide students, whose vocational objectives are such that they will have repeated contact with computers, with a programming course designed to enable them to communicate with the computer in one or more of the most commonly used programming languages.
   3. They should provide sufficient computer training so that graduates of these institutions who have followed such a program may, without loss of credit or time, enter a beginning program of graduate work in computer science in any institution in the state or in the nation.

B. All of the universities and at least some of the colleges should eventually provide programs leading to the Bachelor's degree in computer science. (The programs currently proposed at the University of Kansas leading to degrees in mathematics, electrical engineering, or business, with emphasis on the computer fulfill this need satisfactorily.)

C. All of the universities, but none of the colleges, should provide graduate programs leading to the Master's degree in computer science.

D. Finally, there should be at least one Ph.D. program in computer science in the State of Kansas. At present, it appears that the University of Kansas will soon achieve sufficient strength in computer science to be able to offer this degree.

How well are our institutions meeting these goals today, and what must be done to strengthen them?

The University of Kansas

A Department of Computer Science was established at the University of Kansas in 1968 with Professor Earl J. Schweppe, formerly of the University of Maryland, as Chairman. For its first year of operation, the Department has approximately five full-time equivalent faculty members and five FTE teaching assistants. It is currently organized as an all-University Department reporting directly to the Dean of the Faculties. The only degrees it offers in its own right are at the graduate level and, at the present time, the only graduate program is the program leading to the Master's degree. At the undergraduate level, the Department cooperates with the Department of Mathematics, the Department of Electrical Engineering and the School of Business to offer degrees in these respective colleges with concentration or emphasis in computer science. Some of the members of the faculty have a strong research orientation and it is therefore likely that the Department of Computer Science at the University of Kansas will soon be in a position to offer the Ph.D. in computer science.

The Kansas State University

In 1967 Kansas State University established programs in computer science under the auspices of the Department of Statistics, which is now known as the Department of Statistics and Computer Science. These include undergraduate programs leading to Bachelor's degrees in computer science and a graduate program leading to the Master's degree. The faculty in computer science alone consists of four full-time equivalent faculty members and five full-time equivalent graduate assistants. At the present time, the computer science faculty offers a list of about 20 courses. The computer science faculty at the Kansas State University does not now have the strength of the faculty at the University of Kansas. It is a small faculty upon which severe demands have been placed by the popularity of computer science with the undergraduate and graduate population. With increasing support, it may have the potential to grow into a faculty capable of offering the Doctor's degree in computer science.

Wichita State University

Wichita State does not now have a computer science program. Elementary programming courses are taught in the Department of Aeronautical Engineering, in the Department of Administration of the College of Business Administration and in the Department of Mathematics.

All of these departments provide some additional training in programming and computer applications. Some of these courses are specifically concerned with the subject matter of their respective departments. For example, the electrical engineering courses in computer design, communication, and information theory, pulse and digital switching circuits; or an industrial engineering course in numerical control. Others might be properly brought together into a Computer Science Department, thus providing more uniform syllabi and eliminating some duplication.

We are of the opinion that Wichita State should begin immediately to upgrade its computer science program. This may involve the establishment of a separate Computer Science Department. But, it is also possible to establish such a program in an existing department. Initially, such a program should fulfill the requirements of 1, 2 and 3 above. Eventually, it could be extended to provide the Bachelor's and Master's degrees.

It is probably useless to attempt an expansion of the computer science program at the Wichita State University unless it is also accompanied by an improvement in the computer facilities at the University. It is clear that the computer facilities at Wichita State are severely overburdened at this time and cannot undertake the additional load resulting from expanded offerings in computer science. In other words, any attempt to expand the computer science program at Wichita State must be accompanied by an improvement in the facilities at the Computing Center.

Kansas State Teachers College at Emporia

"The academic areas that teach courses involving the computer are the Business and Business Education Division, the Mathematics Department, and the Library School.

"The business offerings include 24 hours of undergraduate business data-processing and 19 hours of graduate work in the area of data-processing. The graduate courses are designed mainly to prepare teachers for junior college and college teaching positions. The Mathematics Department offers one senior-level programming class (FORTRAN). The Library School offers 6 hours of graduate-level courses."

The courses offered in business are integrated into a program leading to a Bachelor's degree. This program is heavily business data-processing oriented, with most of the cognate work being in business-related subjects. It is notably weak in mathematics and would not, in fact, provide a background sufficient to admit its graduate either to the University of Kansas or to Kansas State University for a graduate program in computer science.

The program at Emporia does not include a computer appreciation course suitable for students with widely varying backgrounds; nor does it include courses offering the student a theoretical background in computing. The senior level course in FORTRAN, taught by the Mathematics Department, is undoubtedly sufficient to give math majors a quick introduction to computing, thereby making them more employable. However, it is not sufficient to bring the graduates of the mathematics program up to the point where they can compete with other professional programmers without considerable on-the-job training. We recommend that this course be opened to freshmen and sophomores in all sciences and that subsequent courses be developed to produce professional programmers. We predict that if the academic prerequisites for admission to this FORTRAN course and other computer courses are lowered, undergraduate students will flock into the courses, with the result that the existing facility will quickly become overloaded, and the need for additional computing facilities will become apparent.

> Note: Both Emporia and Fort Hays (below) report a one semester course in electromechanical devices--the classical IBM or EAM machines. While these machines continue to be important auxiliaries in any computing operation, we feel that they do not require the emphasis of an entire one-semester course and that a sufficient acquaintance with them may be gained in a few weeks of study in a course devoted to electronic computer programming and use. In other words, we recommend the de-emphasis of electric accounting machine programming and use at the college level.

Fort Hays Kansas State College

Fort Hays offers several computer related courses in the Department of Business and two in the Department of Mathematics. The courses in the Department of Business include an introduction to data-processing with its laboratory, referring to electromechanical machines, Computer Programming I, Computer Programming II, Advanced Programming Systems and a Data-Processing Field Project. The courses in the Department of Mathematics are an introduction to FORTRAN programming, currently limited in registration to juniors and seniors, and a course in numerical analysis and digital computation. There does not appear to be a formal Bachelor's degree program with emphasis on data processing or computer programming, either in the Division of Business and Economics or in the Mathematics Department. The computer-related courses offered in the Mathematics Department, if supplemented by some of the courses offered in the Division of Economics and Business, would give a math major sufficient background to embark on a program of graduate study.

It is not unlikely that a graduate in the Division of Business and Economics would need to secure additional background in mathematics before entering on a graduate program in computer science.

Fort Hays also mentions the need for the purchase of a used IBM accounting machine in order to provide experience for students in the punched-card data-processing classes. As indicated in the note above, it is our opinion that the techniques for using this obsolescent equipment are not properly a part of the college curriculum and it is recommended that any requests for adding this kind of equipment to the College installation for this purpose be denied.

Fort Hays Kansas State College does not appear to offer any computer appreciation course suitable for students with widely varying backgrounds.

The Administration at Fort Hays takes a fairly realistic view of the necessity for improving the computer installation if the College is to provide proper facilities for those students with an interest in computers and data-processing. It is a lack of suitable equipment as well as a lack of staff which requires the Department of Mathematics to restrict its FORTRAN course to students at the junior and senior level. As we have mentioned in connection with Emporia, ideally this course will be available to students at the freshmen and sophomore level, but it is apparently now impossible at Fort Hays to handle the load which would result from opening it to students in their first two years of college.

Kansas State College at Pittsburg

Most of the computer courses at Pittsburg are offered by the Department of Business Administration. There are ten courses: three of them at the freshman level, two at the sophomore level, four at the junior level and one at the senior-graduate level. Of these, one of the freshman courses is related to punched-card data-processing, one of the junior courses appears to be a computer appreciation course such as we have mentioned, and the remainder of the courses appear to be largely concerned with programming and business data-processing. In the Mathematics Department, there is one junior course in FORTRAN programming and one senior-graduate course in Numerical Analysis. It is possible for a student at Pittsburg to gain a Bachelor's degree with a major in Business Administration and with emphasis on computer data-processing, but such a student might not gain sufficient formal mathematical background to insure admission to a graduate program in computer science. On the other hand, it is still possible for the student who desires to pursue a course in graduate study in computer science to obtain the necessary prerequisites at Pittsburg.

From the point of view of computer education, the staff at Pittsburg is quite aware of the limitations of the equipment. They are afraid that increased registration in courses teaching FORTRAN and other higher level languages would produce a situation with which present equipment could not cope. Consequently, Pittsburg is preparing a proposal to the National Science Foundation on a project to study the use of the computer as a tool in instruction. This proposal involves teaching three to six hours of computer science to all business and mathematics majors. The college seeks by this means to justify the installation of a third generation computer with remote terminal access. Failing this, they see the need for remote terminal access to a third generation computer at some distance from the campus.

K.U. Medical Center

In the Medical Center, at the present time, and in keeping with its primary mission, there are no formal computer courses carrying graduate or undergraduate credit. Naturally, there are some informal non-credit seminars in computer programming offered for Medical Center researchers and their staff.

In view of the increasing use of computers in research and patient care, as well as their natural use in the business operations of health care institutions, it would seem desirable to institute some formal courses in computers, perhaps carrying undergraduate credit for students in paramedical courses such as nursing, medical technician, x-ray technician, etc. A health care oriented computer appreciation course or seminar for medical students would also be a desirable addition. If it does not formally recognize the influence of the computer in the health sciences, the Medical Center will be failing to provide adequate preparation for future practioners, researchers and their aides.

Vocational Education

The State colleges have been receiving some computer support from the State Board of Vocational Education. In return for this support, the colleges agreed to provide computer training in a two-year program of vocational education. The support was given on a matching fund basis; it related both to teaching faculty in the computer science area and the support of the hardware installed at the colleges. In the most recent year, the amount of this support has dwindled so that relative to the total budget of the computing center at each such college, it has become an insignificant amount.

In 1968, the Board of Vocational Education was combined with the State Board of Education. In late 1968 an official of the State Board of Education, with the encouragement of the Computer Systems Analyst in the Office of the State Department of Administration, proposed to install a central computing facility to serve the needs of all the vocational-technical schools as well as interested high schools and junior colleges. In order to provide sufficient support for the projected system, it was proposed that the support for vocational education in computers currently going to the colleges be removed and that the colleges put up the matching funds donated to this program to support the centralized computing facility. It is our impression that the colleges are not enthusiastic about participating in such a centralized vocational education computing facility, particularly if it places an additional financial burden on them, and prefer instead to give up the funds which they are currently receiving in support of the vocational education program.

While this Committee is certain that the colleges assumed their computer vocational education responsibilities in good faith, it has developed that most of the students who have embarked on the two-year vocational education program have elected at the conclusion of that program to continue in the colleges and to complete a four-year program in computer science. It is therefore not surprising that those in charge of the State Vocational Education program should prefer to support the two-year program at other locations.

While this Committee supports the notion that centralized computing facilities for educational purposes are eminently sensible (compare other sections of this report), it is also our opinion that, since secondary and vocational education are concerns of a distinct administrative agency, the four-year colleges and universities under the Board of Regents should not be involved in this vocational education program. First, this will eliminate crossing and conflicting lines of communication and administration. Second, it is clear that the colleges, by and large, are not interested in continuing a relationship with the vocational education program except insofar as they are preparing teachers for that program.

Recommendation 7: It is recommended that six distinct levels of instruction be identified in the state supported colleges and universities:

A. Computer Appreciation--providing a reasonable understanding of the properties and uses of computers for the average college-trained individual.

B. Elementary Programming--teaching students the use of computers as a tool for key disciplines.

C. Intermediate--providing the minimum prerequisites for future graduate work in computer science.

D. Major Programs leading to the B.S. or B.A. in computer science.

E. The Master's degree program.

F. The Ph.D. program.

Recommendation 8: The Committee further recommends that:

A. All the Regents' institutions should, as a minimum provide instruction at the first three levels identified above.

B. All of the universities and some of the colleges should eventually provide programs leading to the Bachelor's degree in computer science.

C. All of the universities should provide graduate programs leading to the Master's degree in computer science.

D. There should be one Ph.D. program in computer science in the State of Kansas.

Recommendation 9: Computing facilities and staff adequate to the mission of the institution should be available to all Regents' institutions to support the preparation of students in all disciplines.

Recommendation 10: Since secondary and vocational education are concerns of a distinct State agency (State Board of Education), it is recommended that the junior colleges, area vocational technical schools and those high schools which wish to participate, be given the responsibility for the two-year training of technicians and computer operators, while the colleges and universities educate professional systems analysts, programmers, and computer scientists. It is recommended that the colleges and universities not participate in the two-year vocational education programs.

CHAPTER IV

Computer Hardware and Computer Network

The recommendations of the Computer Study Committee relative to equipment embody its conviction that a State-wide computing network is a proper goal for computing in higher education. The ultimate system, a State-wide utility, which provides computing power universally and contains within itself the accumulated knowledge and information-processing capabilities of all State educational institutions, will require years of cooperative planning and effort. The technology and economics of computing are clearly moving in the direction of the large centralized Computing network. The recommendations of this chapter are that the computing installations in the Board of Regents Institutions advance toward the evolution of a computing network serving the Kansas Institutions of higher education.

As background for the recommendations related to equipment, a discussion of trends in the design and use of computers is presented. Much of this material is amplified in the publications listed at the end of this section. In particular, the report of the President's Science Advisory Committee "Computers in Higher Education" and the report "Digital Computer Needs in Universities and Colleges," published by the National Academy of Sciences and the National Research Council, are two extremely valuable sources of information on the problems of computing in higher education.

The rapidly advancing technology of the design and manufacture of computers has in less than 25 years produced three generations of computing equipment. The first of these is characterized by the use of vacuum tubes, the second generation by the use of transistors and magnetic storage devices, and the third generation by integrated circuits or micro-miniature electronics.

Paralleling the evolution of the three generations of computers has been the evolution of philosophies of utilization of the computer resource. When computers first become commercially available, they were conceived as general purpose instruments to do all kinds of computations in all possible types of problems. The high cost of equipment coupled with distinct kinds of computational requirements in scientific research (vast numerical calculation) and administrative computing (little calculation, much file and data manipulation) led to the design and manufacture of two distinct kinds of computers in the second generation. There two kinds of computers are (1) the word machine with high computation speeds and (2) the character machine with poor computation speed but great capacity for manipulating data files. Examples of the second generation scientific type computer are the IBM 7000 series, including the 7040, 7044, 7090, and 7094, while representing the data-processing type computer is the IBM 1400 series, including the 1401, 1440 and 1460. These machines were specifically designed to be more cost-effective in specialized areas of operation and hence each may be inefficient in the alternative area.

The Case for Administrative Computing Based on IBM 1401 Systems

Successive generations of computers generally reduce the costs of computing. Thus, a job run on a second generation computer would cost less than the same job run on a first generation computer of approximately the same size. Similarly third generation computers reduce problem solving costs compared with second generation systems. To prevent the accumulation of large inventories of obsolescent or obsolete computing equipment, manufacturers have significantly discounted second-generation computing equipment to non-profit organizations. This has had the effect, at least temporarily, of nearly balancing the cost-performance figures for second-generation equipment and third-generation equipment, leaving only the question of the adequacy of second generation equipment to the required tasks.

It is in this context that the evaluations and recommendations of the committee with regard to the IBM 1401 computer installations in the institutions of higher education in the State of Kansas were made. All three colleges in the State have IBM 1401 systems with disk storage installed. In addition, 1401 systems comprise part of the computer complement at the University of Kansas in Lawrence and at Kansas State University in Manhattan. An IBM 360/30 is installed at the Medical Center and it has 1401 emulation capability. Thus, six of the seven installations in the State Institutions of Higher Education currently have the capacity for doing administrative computing using programs which could be exchanged between installations. Wichita State's recommended IBM 360/44 with its requested options would also be compatible in the sense described. In all cases, the 1401 equipment is being used currently for administrative computing.

Until this year, there were more 1401's installed in this country than any other single computer and they were almost exclusively dedicated to administrative data-processing. Consequently a large number of tested programs have been developed for use on 1401 systems. The Kansas institutions of higher education have developed many programs to solve the administrative problems directly associated with their operations. The value of these existing programs and the compatibility between the various institutions' facilities support the recommendation of the committee that the 1401 equipment be retained for the present in the colleges as the basis of computing support for administrative data processing. It is urged that the State's institutions of higher education collaborate in a review of this 1401 computing resource. Each installation should accommodate the exchange of programs and activities with other installations, should be compatible with the other installations, while maintaining an ability to handle the unique local requirements for administrative computing.

The 1401 is not designed to handle applications requiring extensive computations nor is it designed to permit economical access from remote terminals. These two kinds of activity are essential in education and scientific research. For this reason, the 1401 is poorly suited to handle the full scope of computing activities on any campus.

The recommendation of the committee for the utilization of the 1401's for administrative computing is a temporary measure until technical advances make it feasible to serve the administrative computing needs of all the institutions system in a network mode. While most third generation computing equipment has the capability of computer to computer communication, the current technology, and especially the costs of massive data transmission, make immediate translation of administrative computing to a network environment uneconomical. Thus, the recommendation to retain second generation administrative computing equipment temporarily is based largely on the realities of available programming and operating systems, of current limitations on communications for administrative computing, and of providing an environment in which efforts leading to the eventual standardization of administrative computing activities may be nurtured. It is expected that these administrative computing activities can become part of a State-wide computing network in the future, with certain institutions designated to handle certain administrative computing functions for the entire network. The plan now suggested by the committee is to identify the appropriate functions, to designate the appropriate institutions, and to coordinate current administrative computing functions to standardize as many activities as possible. Standardization in the current environment will provide for a smoother future transition to network administrative computing.

The Case for Centralization and Network Computing

With development of third generation computing equipment, the computing industry has provided a resource which can operate on multiple programs simultaneously and can handle over multiple communication lines a variety of terminals conveniently located for the users of the resource. This is a computing utility analogous to the familiar telephone utility. Such a computing network is of monumental complexity. The computer itself has been described as the most complex instrument ever devised by man; when it is used in a multiple accessing, multiple programming, centralized network environment, the basic complexities are increased by at least an order of magnitude. However the costs of these complexities of organization, implementation, and utilization are off-set by the value of the superior services offered to those requiring the resource when compared to the service provided a similar number of users by many distinct computer systems of less power.

Chapter six of the book "The Challenge of the Computer Utility", by Douglas F. Parkhill, contains an excellent statement of the arguments relating to the development of the computer utility.

The proponents of the computer network concept offer two generally distinct types of arguments in support of its development. These are:

1. That there are certain classes of computer applications which become feasible (except perhaps at an exorbitant cost) only in a large central computer facility shared on-line by a number of remotely located users. This can be called the special service or cost-be-damned argument.

2. That the computer utility can provide better service at a smaller cost than that available at a private installation. This is the cost/effectiveness argument and if it proves correct in the long run computer utility networks will develop and flourish.

Transition to Network Computing in Kansas Institutions of Higher Education

The investigations of the committee revealed several important features of computing in the Kansas institutions of higher learning. The University of Kansas and Kansas State University have relatively large third generation computers as their central computing resources. Third generation computers are also installed at the Medical Center and in Wichita State University's Computation Center, but in both these installations the equipment is the small to medium computer. The three state colleges have installed second generation IBM 1401 computing equipment as their only available resources.

The use of computers on the different campuses also presents a broad spectrum. The variety of equipment and the wide spectrum of computing needs found on the various campuses of the state suggest the development of a network computer utility to serve more effectively the state-wide educational needs for computing.

As a first step in the direction of examining the network concept, the committee recommends the immediate installation of a telephone communications systems permitting direct communication between the computer facilities at any two state institutions. The map in figure #1 shows rough estimates of the mileage: If a switching system is based in Topeka, a total of about 725 miles of telephone lines would be required to connect each institution's computing facility to the central switching equipment. The communication costs for such a network, with 4 kilocycle channels connecting each computer facility to the central switching network, would be approximately $28,000 per year. Adding the costs of terminals comparable to the Model 35 Teletype brings the annual cost for interconnecting the seven institutional computing facilities to approximately $40,000.

The installation of this communications network would be the first step toward the development of a computing network and includes the following: a) Access to the time-sharing computing system at the University of Kansas by every student and faculty member throughout the Board of Regents institutions in Kansas. This time-sharing facility provides two interactive programming languages (BASIC and FORTRAN) for program writing and debugging and includes access to the largest library of programs in active use in the state. Computer science instruction throughout the state would benefit by the availability of programs for Computer Science education developed at the University of Kansas (the colleges in the state currently use their IBM 1401 systems, inefficient for such work, to support their instructional programs). b) Access to the IBM 360/50 at Kansas State University and the availability of the vast program library available to users of IBM equipment throughout the

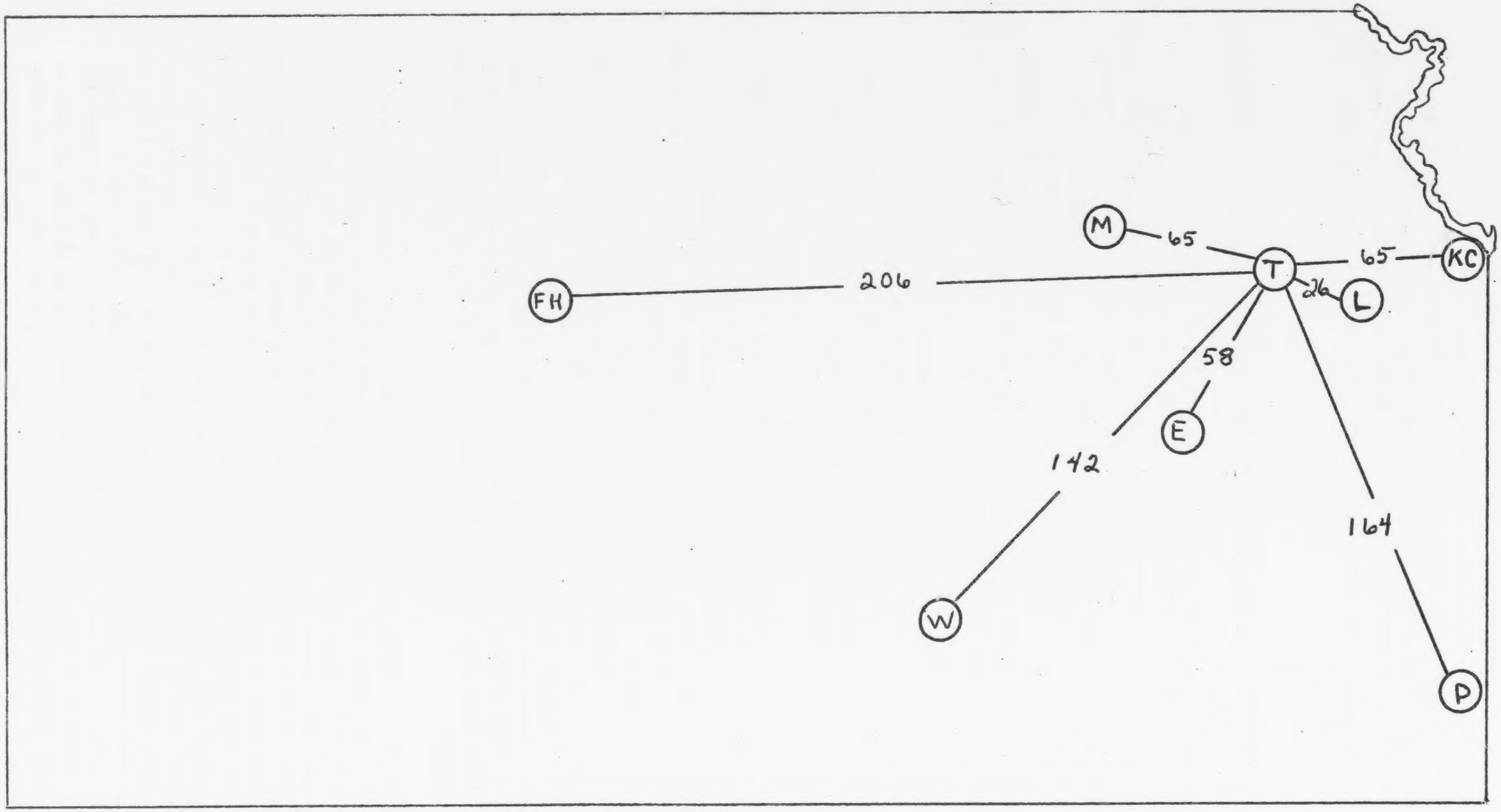

FIGURE 1

Approximate Milage Between Campuses and Topeka country. Because the IBM 360/50 is the largest IBM computer in the state educational network, it would provide a facility for programs developed for the System 360 which cannot be run on other network computers. The entire state educational network could benefit from the efforts and expertise of the staff at Kansas State and of IBM computer users throughout the country. c) The capacity to communicate between individual institutions would enhance the cooperative efforts on the various campuses in all areas of computer applications. In particular, the recommended standardization in administrative computing activities would be enhanced by the ability for direct communication to exchange ideas and programs.

While the telephone communication network provides a state-wide but modest step toward network computing, an experiment with the actual utilization of a large-scale facility from a remote terminal is essential to a proper evaluation of positive and negative factors in this approach for state institutions of higher education. Therefore it is recommended that one of the state's colleges and one of the state's universities be selected to establish a prototype network for instructional and research computing at the college using the university's computing facility.

For illustration let us assume that Pittsburg State College is selected to work with the University of Kansas in Lawrence. The cost of providing this service includes three components: 1) The costs of using the central computer; 2) the costs of the consoles; and 3) the charges for connecting the consoles to the central facility.

The cost of the computing resource utilization at the central facility is extremely difficult to estimate. It depends on the nature and volume of programs run. These are highly variable, and experience has shown that total use will increase sharply with the availability of remote access to the central resource. One statement can be made: whatever the cost of computing at the central computer, it would be significantly lower than the same computing power provided at Pittsburgh State by installation of a small computer independently supported to provide the same service. A very rough estimate is that by the end of the first year Pittsburg would be using at most 1/50 to 1/30 of the resource at Lawrence, at an expense of $1500 to $2000 per month.

The estimate of costs for consoles to support a college the size of Pittsburg State is derived from the report entitled, "Computers in Higher Education", Appendix G, which suggests that each terminal can serve approximately 200 student users in the normal instructional computing environment. Pittsburg State reports enrollments of about 750 students in Computer Science courses, which indicates a 4 terminal installation as a minimum to support this activity. Adding one terminal specifically for research activities brings the total to five.

A Half Duplex 2400 BAUD communication line of length 150 miles between Pittsburg and Lawrence, and its terminations, costs about $350 per month. Thus, each terminal connected to the computing facility in Lawrence would cost about $500. Assuming 5 lines are provided, the costs of consoles and transmission charges for the entire installation are estimated at $2,500 a month, or approximately the cost of a modest third generation computer, such as a 32K IBM 1130.

The contrast in the computing power made available at the Pittsburg campus by this investment of dollars, as opposed to installation of a small computer private to the Pittsburg campus deserves some elaboration. Currently available in the time-sharing system at Lawrence are the conversational languages BASIC and FORTRAN, a complete library of statistical analysis programs, additional programming languages including SIMSCRIPT (a simulation language), standard versions of FORTRAN IV, COBOL, and ALGOL, and a list-processing language SNOBOL (which is extremely useful for Computer Science instruction). Users of the terminal installations at the Pittsburg campus could use the full power of a large-scale General Electric 635 computer installation. They would also have the immediate capability to interact with the research, instructional and administrative computing activities on the Lawrence campus. On the other hand, the IBM 1130, which is representative of a modest computer renting for about $2,500 a month, provides as programming languages FORTRAN IV, SL/1 (Sub-set PL/1), and APL (the Iverson language). It also provides an extensive scientific subroutine package, the continuous system modeling program (CSMP), COGO and STRESS for engineering calculations and a well-designed statistical package. In addition, the 1130 can handle one or two remote consoles and can also serve as a batch terminal connected to a larger remote computer.

Another benefit for Pittsburg from installation of remote terminals (or a modest third generation computer) would be the relief of the installed IBM 1401 administrative computing system. The 1401 might thus be reconfigured to serve only the administrative needs at Pittsburg thus facilitating efforts toward standardization of administrative computing functions. This might result in reducing the required 1401 computing power but this is not a guaranteed result of installing terminals to support instruction and research. Nevertheless removal of the requirement that the 1401 support instruction and research would greatly enhance its capacity to serve the administrative computing functions at Pittsburgh State.

For purposes of this illustration then, a prototype network utility installation could be provided between the Lawrence and Pittsburg campuses for approximately $2500 per month in addition to actual computing costs incurred at the central facility. This installation would permit a rigorous assessment of the value and merit of using a centralized network utility to support instructional and research activites in a state-wide network.

It is urged by the committee that the Board of Regents assign the responsibility for developing such a prototype system to a college and a university selected from the seven Board of Regents institutions and that the Board recommend support for the costs of appropriate equipment. It is further recommended that the Board charge its Computer Committee with the responsibility for conducting a thorough investigation of this model installation giving regular reports on its progress, and producing a summary report at the end of the first year of installation, detailing the advantages and disadvantages of providing computer service in this mode.

It is recommended that, in addition to the installation of the telephone communication links between the computer centers on the various campuses, each campus administration should move toward the centralization of its own computing enterprises. The philosophy of locally centralized computing dovetails with the philosophy of network computing by providing at the central computing facility a focal point for communication between campuses. To do administrative computing in a state-wide network will be feasible only if its standardization is begun in the present environment. The ability of the various computing activities on a single campus to work together is an essential step toward the capacity for cooperative computing among the several campuses of the state's institutions of higher education.

Summary

The Committee urges the move toward a network capability connecting the state institutions. This recommendation does not eventually imply a single computer at one institution with all other institutions feeding problems to it and depending on it for answers. However, it does mean that direct-line communication between computing facilities on the various campuses should be established as a first step and that planning for expansion and replacement of computing equipment ought to be reviewed on a state-wide basis, taking into account the possible overall benefits in computing service and costs. It should be understood that the cost of the entire state-wide enterprise will probably not be reduced by sharing facilities, but the total increase in the cost of supporting the computing enterprise across the state can be kept as low as possible while providing the necessary computing power.

In the current state of technology, the capacity to do computing from a remote terminal tied to computer used as a network node-point is limited to scientific research and to instructional activities including conversational interaction (Time-Sharing); this work usually requires only modest volumes of data to be transmitted in either direction. In short, it is not now economical to handle remotely those activities which require massive transmission of data to the computer or of reports to the remote terminal.

Hence administrative computing requirements will probably best be handled on the individual campuses for the present, but remote access to a large-scale computer may best serve the instructional and research needs of the entire community of institutions under the State Board of Regents.

This conclusion implies certain constraints on the future arrangements for equipment in the seven institutions. While fully equipped and fully staffed modern computing installations at each institution might be desirable, the costs may be prohibitive. The opposite extreme of a single centralized computing resource is also worth examination, but it cannot provide relief for the existing problems of computing on the various campuses. Thus, the committee recommends a deliberate approach toward network computing as follows:

1. Direct voice grade communication lines should be installed connecting all seven computer installations under Board of Regents authority. These lines should be dedicated to data communications and voice communication between computer installations.

2. Each institution should install a simple communications terminal to utilize the available computing resources at other sites in Regent's institutions and outside. Such a terminal might be portable (acoustic coupled) and should provide a character set compatible with all installations. Many varieties of terminals are available, so some uniformity of selection is recommended.

3. This study indicates that some of the current computing needs, particularly instructional and research, at the colleges could be better served by developing a terminal network appropriately designed for their requirements, than by attempting to raise the several installations to levels which could handle the scope and volume independently on each campus. This observation leads to the recommendation that the Board of Regents proceed immediately to establish a prototype remote terminal installation on some selected college campus and to initiate a study and evaluation of the benefits and costs of this installation.

Recommendation 11: The existing IBM 1401 computer systems at the colleges are appropriate for their present administrative computing needs. The Committee recommends the colleges assure themselves that the 1401 facilities are adequately staffed and maintained to handle their administrative needs. Instructional and research computing needs may be met by augmenting these facilities with equipment which would provide conversational and/or remote batch access to larger facilities in the State or elsewhere.

In order to investigate the cost and feasibilty of such an approach, it is recommended that one college be selected to install such a terminal facility as a pilot project.

Recommendation 12: It is recommended that a telephone network be planned and installed to permit transmission of information between the several computing centers of the Regents' institutions. It is further recommended that a study be initiated leading to the establishment of a unified computer network linking these institutions.

Recommendation 14: It is recommended that centralization of computer facilities be encouraged at all the institutions to provide adequate service for all users. Centralization of computing is desirable, both academically and administratively.

CHAPTER V

Review of Computing Center Space Facilities in Regents' Institutions

At each institution, the computing center operates 12 to 24 hours a day. Considering the magnitude of the respective operating budgets, probably more dollars are expended per square foot of space and the facilities are occupied more hours per day than in any other area on the campus.

Although the computer has been heralded as a tireless and fantastically efficient resource when properly utilized, it is clearly dependent upon management, operations, and programming personnel who are neither tireless nor fantastically efficient, particularly when forced to work in cramped and otherwise inadequate physical facilities.

The Committee has developed two formulas for computing center space as a function of operating budget level. The formula yielding the lower values is called the "Essential Space formula" and the one yielding the higher values is called the "Desirable Space formula." In using these terms, the Committee means the following:

1. Essential Space is the minimum space necessary for reasonably smooth operation of the center at the present instant. In other words, any center whose space versus budget point drops below the line defining essential space is operating in inadequate and crowded space.

2. Desirable Space level is that which is truly adequate and permits smooth operation of the center. An institution whose space versus budget point lies at or above the desirable level, should be able to enjoy several years of relatively comfortable operation before its space versus budget point falls below the essential level.

The formulas are as follows: The minimum essential space is 1,000 square feet plus 8 square feet for each $1,000 of operating budget. Desirable space is 1,500 square feet plus 10 square feet for each $1,000 of operating budget. These two formulas are represented in the graph on the following page.

The following illustration may be helpful: Suppose a computing center is operating on a current annual budget of $625,000 in an area of 10,000 square feet. According to the formulas it is enjoying adequate space. When the annual budget reaches $875,000, the situation moves into the region between desirable and minimum essential space. The management of the center should immediately take action to increase the available space by approximately 4,000 square feet so that when the budget reaches $1.175 million, it can comfortably pass from the region of inadequate space again to the region of adequate space. This new area of 14,000 square feet will then be adequate until the budget reaches $1.625 million, when the center should again be expanded into larger quarters.

The human animal can adjust its system to wide variations in ambient temperature and humidity, but computing hardware is not so fortunate. A properly designed computing facility must provide air-conditioning of the machine room, even though the outside temperature may be below zero (attempts to cool equipment with cold fresh air are poor practice in Kansas since humidity control is required and disk and tape operations make dirt and dust control mandatory). Ideally, the environmental control should keep ambient temperatures at 72 ± 2 degrees and relative humidity at 50% ± 10% the year around.

Adequate housing for computing is the individual responsibility of each institution. It is recommended that institutional planning for future building development give high priority to adequate space for computing.

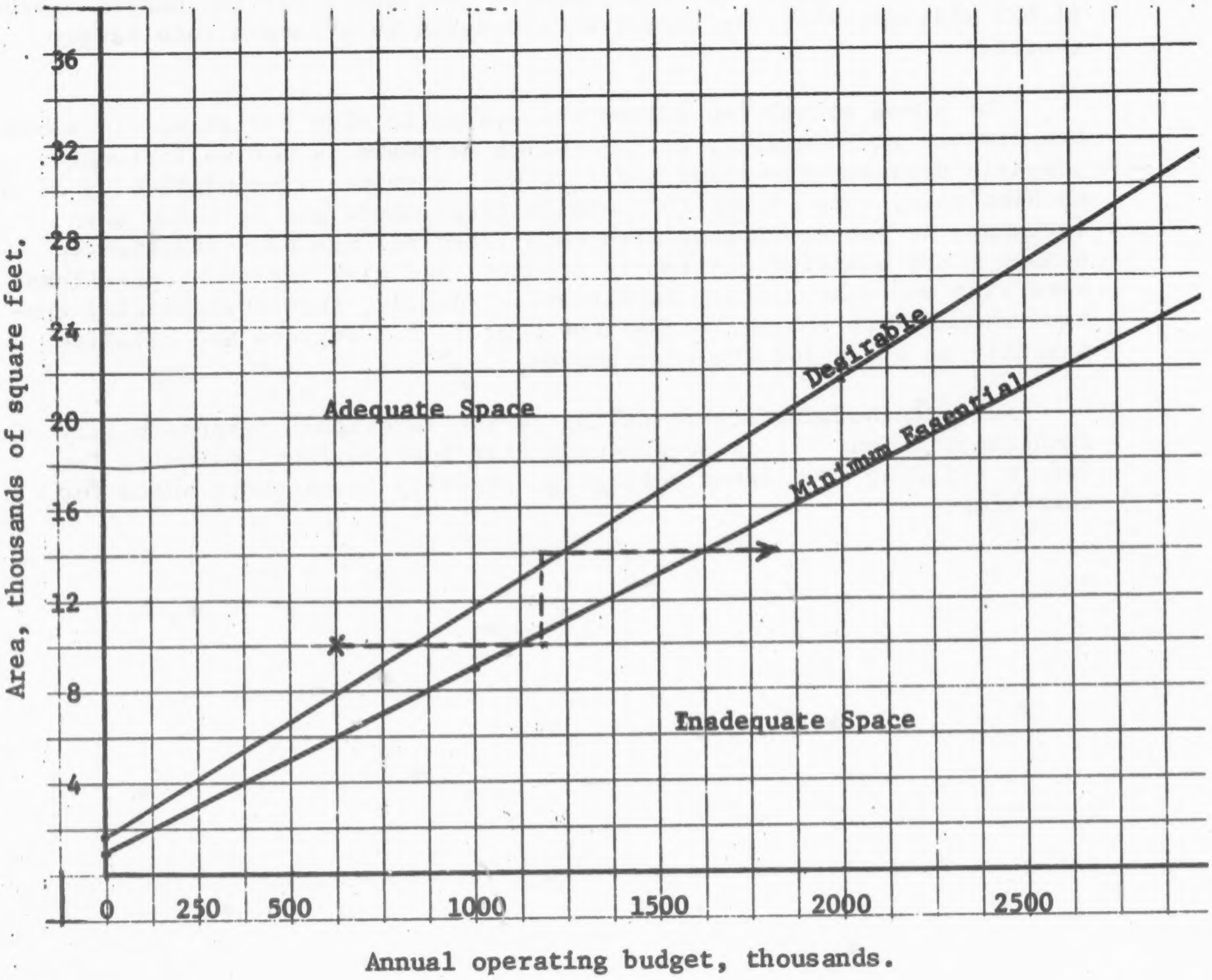

Figure 5.1

Space Formulas with Example

Present and Anticipated Space Requirements

for Computing Centers

Square feet (thousands)

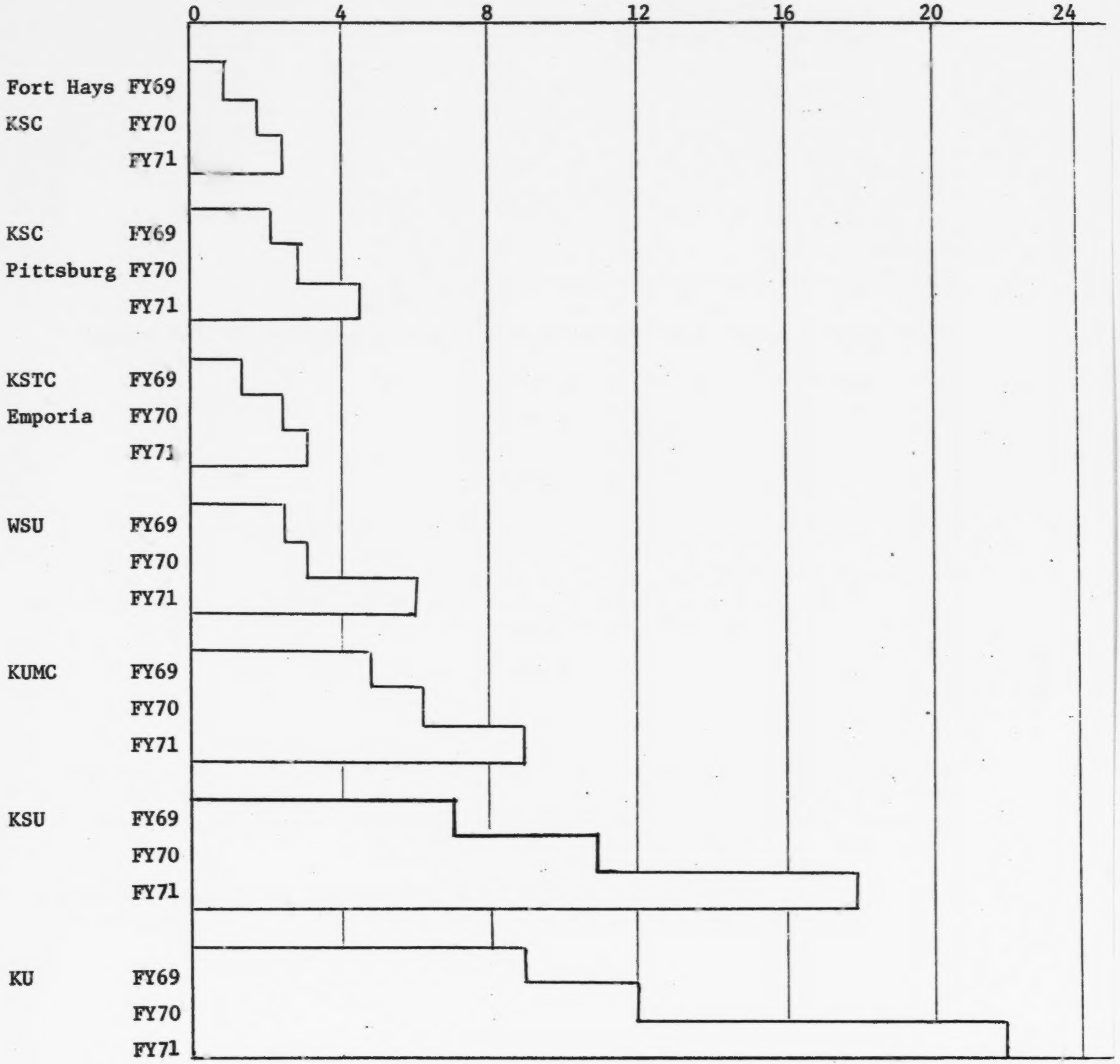

Figure 5.2

UNIVERSITY OF KANSAS

Division of Present Square Footage:

Use	Present Sq. Ft.	Percent Of Total	Average Over All Centers
Computer Hardware	2,194	24.7%	24.6%
Unit Record Functions	402	4.5%	10.0%
Keypunch (Incl. Stud.)	554	6.2%	9.1%
Office	3,737	42.0%	36.6%
Special Purpose	1,133	12.7%	8.2%
Storage	524	5.9%	8.3%
Other (Hallways, etc.)	350	4.0%	3.2%
Total Present Area	8,894	100.0%	100.0%

Fiscal Year 1969 Operating Budget $1,150,194.

Areas as calculated from Committee space formula based on FY 1969 Budget:

Essential Space Needs = 1,000 + 8 x 1,150
= 10,200 sq. ft.

Desirable Space Min. = 1,500 + 10 x 1,150
= 13,000 sq. ft.

Square Feet Requested for this Fiscal Year - 12,000 sq. ft.

For Fiscal Year 1971 the projected operating budget was $3,000,000 and the requested space was 22,000 sq. ft. Space needs based on the Committee's formula for this operating level would be:

Essential Space Needs = 25,000 sq. ft.

Desirable Space Min. = 31,500 sq. ft.

The current physical facilities at the University of Kansas are below the essential formula space needs and the formula would indicate that the requested 22,000 sq. ft. for a $3,000,000 operating budget is obviously inadequate.

A new facility, expandable to 30,000 to 50,000 sq. ft. is clearly indicated.

KANSAS STATE UNIVERSITY

Division of Present Square Footage:

Use	Present Sq. Ft.	Percent Of Total	Average Over All Centers
Computer Hardware	2,507	33.8%	24.6%
Unit Record Functions	505	6.8%	10.0%
Keypunch (Incl. Stud.)	484	6.5%	9.1%
Office	2,208	29.8%	36.6%
Special Purpose	557	7.5%	8.2%
Storage	557	7.5%	8.3%
Other (Hallways, etc.)	602	8.1%	3.2%
Total Present Area	7,420	100.0%	100.0%

Fiscal Year 1969 Operating Budget $743,000

Area required as calculated from Committee space formula based on FY 1969 Operating Budget:

Essential Space Needs = 1,000 + 8 x 743
= 6,944 sq. ft.

Desirable Space Min. = 1,500 + 10 x 575
= 8,430 sq. ft.

Square Feet Requested for Fiscal Year 1969 - 10,900 sq. ft.

For Fiscal Year 1971 the projected operating budget was $1,111,000, and the requested space was 18,000 sq. ft. Space needs based on the Committee's formula for this operating level would be:

Essential Space Needs = 9,888 sq. ft.

Desirable Space Min. = 12,610 sq. ft.

The current physical facility at Kansas State University is near the essential space formula needs. Present space is not contiguous and is not readily expandable. The area used for submitting programs is a bottleneck, and rearrangement here would appear desirable.

The requested 18,000 sq. ft. should meet the center's space needs until their operating level rises above a $2,000,000 annual expense.

KANSAS UNIVERSITY MEDICAL CENTER

Division of Present Square Footage:

Use	Present Sq. Ft.	Percent Of Total	Average Over All Centers
Computer Hardware	950	20.1%	24.6%
Unit Record Functions	300	6.4%	10.0%
Keypunch	459	9.7%	9.1%
Office	2,286	48.5%	36.6%
Special Purpose	304	6.5%	8.2%
Storage	416	8.8%	8.3%
Other	0	0.0%	3.2%
Total Present Area	4,715	100.0%	100.0%

Fiscal Year 1969 Operating Budget $532,850.

Area required as calculated from Committee space formula based on FY 1969 Operating Budget:

Essential Space Needs = 1,000 + 8 x 533
= 5,264 sq. ft.

Desirable Space Min. = 1,500 + 10 x 533
= 6,830 sq. ft.

Square Feet Requested for Fiscal Year 1969 - 6,300 sq. ft.

For Fiscal Year 1971 the projected operating budget was $720,000, and the requested space was 9,000 sq. ft. Space needs based on the Committee's formula for this operating level would be:

Essential Space Needs = 6,760 sq. ft.

Desirable Min. Space = 8,700 sq. ft.

The present physical facility at the K.U. Medical Center is cut up, scattered over many locations, and well below the minimum essential space requirements. In view of the major computer upgrade contemplated in the near future, a new facility is clearly indicated.

The requested 9,000 sq. ft. would only be adequate for an operating level below $1,000,000. Consideration should be given for expansion or the facility would soon be inadequate in terms of space.

WICHITA STATE UNIVERSITY

Division of Present Square Footage:

Use	Present Sq. Ft.	Percent Of Total	Average Over All Centers
Computer Hardware	525	21.0%	24.6%
Unit Record Functions	425	17.0%	10.0%
Keypunch (Incl. Stud.)	340	13.6%	9.1%
Office	850	34.0%	36.6%
Special Purpose	60	2.4%	8.2%
Storage	200	8.0%	8.3%
Other (Hallways, etc.)	100	4.0%	3.2%
Total Present Area	2,500	100.0%	100.0%

Fiscal Year 1969 Operating Budget $238,415.

Area required as calculated from Committee space formula based on FY 1969 Operating Budget:

Essential Space Needs = 1,000 + 8 x 238
= 2,904 sq. ft.

Desirable Space Min. = 1,500 + 10 x 238
= 3,880 sq. ft.

Square Feet Requested for Fiscal Year 1969 - 3,220 sq. ft.

For Fiscal Year 1971 the projected operating budget was $490,000, and the requested space was 6,150 sq. ft. Space needs based on the Committee's formula for this operating level would be.

Essential space Needs = 4,920 sq. ft.

Desirable Space Min. = 6,400 sq. ft.

The current physical facility at Wichita State is contiguous, acceptably arranged, but quite cramped for the work load and personnel now occupying these quarters. The facility is below the formula essential space requirements. Considering that a major upgrade in computer facilities is contemplated, a new physical facility is clearly in order.

The requested space of 6,150 sq. ft. should only be considered adequate for operating levels below $500,000 and 11,000 sq. ft. should be considered for operating levels at the $1,000,000 mark.

KANSAS STATE TEACHERS' COLLEGE OF EMPORIA

Division of Present Square Footage:

Use	Present Sq. Ft.	Percent Of Total	Average Over All Centers
Computer Hardware	504	36.2%	24.6%
Unit Record Functions	553	39.7%	10.0%
Keypunch (Incl. Stud.)	52	3.7%	9.1%
Office	245	17.6%	36.6%
Special Purpose	0	0.0%	8.2%
Storage	40	2.8%	8.3%
Other	0	0.0%	3.2%
Total Present Area	1,394	100.0%	100.0%

Fiscal Year 1969 Operating Budget $187,353.

Area required as calculated from Committee space formula based on the FY 1969 Operating Budget:

Essential Space Needs = 1,000 + 8 x 187
= 2,496 sq. ft.

Desirable Space Min. = 1,500 + 10 x 187
= 3,370 sq. ft.

Square Feet Requested for Fiscal Year 1969 - 2,450 sq. ft.

For Fiscal Year 1971 the projected operating budget was $215,000, and the requested space was 3,100 sq. ft. Space needs based on the Committee's formula for this operating level would be:

Essential Space Needs = 2,720 sq. ft.

Desirable Space Min. = 3,650 sq. ft.

The current physical facility at Emporia State is less adequate than that at ANY OF THE OTHER INSTITUTIONS. The fact that this computing center is doing more in less space attests only to the skill and resourcefulness of its management.

In planning for new facilities it is recommended that at least 3,500 sq. ft. and preferably 4,000 sq. ft. be considered, and that adequate office and storage space be provided as well as proper environment in the machine rooms.

FORT HAYS KANSAS STATE COLLEGE

Division of Present Square Footage:

Use	Present Sq. Ft.	Percent Of Total	Average Over All Centers
Computer Hardware	285	30.3%	24.6%
Unit Record Functions	322	34.2%	10.0%
Keypunch (Incl. Stud.)	208	22.1%	9.1%
Office	40	4.2%	36.6%
Special Purpose	0	0.0%	8.2%
Storage	87	9.2%	8.3%
Other	0	0.0%	3.2%
Total Present Area	942	100.0%	100.0%

Fiscal Year 1969 Operating Budget $97,369.

Area required as calculated from Committee space formula based on the FY 1969 Operating Budget:

Essential Space Needs = 1,000 + 8 x 97
= 1,776 sq. ft.

Desirable Space Needs = 1,500 + 10 x 97
= 2,470 sq. ft.

Square Feet Requested for Fiscal Year 1969 - 1,834 sq. ft.

For Fiscal Year 1971 the projected operating budget was $107,000 and the space requested was 2,419 sq. ft. This projected budget would not meet even inflationary price increases, and would in essence allow for no increase whatsoever in computing activities.

The requested 2,419 sq. ft. facility should only be considered adequate for operating levels below $180,000.

The present facility of 942 sq. ft. is woefully inadequate by any standard, and should be augmented immediately. Office space for management and programming must be provided. The fact that this computing center is performing its role as well as it does says much for the quality of its direction and the fortitude of its staff.

KANSAS STATE COLLEGE OF PITTSBURG

Division of Present Square Footage:

Use	Present Sq. Ft.	Percent of Total	Average Over All Centers
Computer Hardware	315	14.1%	24.6%
Unit Record Functions	246	11.0%	10.0%
Keypunch (Incl. Stud.)	438	19.6%	9.1%
Office	462	20.7%	36.6%
Special Purpose	258	11.6%	8.2%
Storage	514	23.0%	8.3%
Other	0	0.0%	3.2%
Total Present Area	2,233	100.0%	100.0%

Fiscal Year 1969 Operating Budget $107,855.

Area required as calculated from Committee space formula based on the FY 1969 Operating Budget:

Essential Space Needs = 1,000 + 8 x 108
= 1,864 sq. ft.

Desirable Space Min. = 1,500 + 10 x 108
= 2,580 sq. ft.

Square Feet Requested for Fiscal Year 1969 - 2,734 sq. ft.

For Fiscal Year 1971 the projected operating budget was $115,000, and the requested space was 4,550 sq. ft. This projected budget seems unrealistic and would not even be sufficient to meet inflationary price increases, let alone expansion of computing capability. But the 4,550 sq. ft. requested facility would accommodate the center's operating requirements up to a $400,000 annual operating level in terms of today's technology.

The Administration of this Institution is to be commended for recognizing the importance of computing on its campus as evidenced by the space which it has provided and is planning to provide for computing activities. However, the projected operating budget is not consistent with the role which this Institution is likely to play in Kansas Higher Education.

Recommendation 13: Space for computing is a major problem at all institutions. Two institutions are presently suffering a loss of efficiency because of inadequate and fragmented space, while perhaps only one institution (Pittsburg) is adequately housed. Institutional planning for future building development must give high priority to space for computing.

CHAPTER VI

Administrative Data-Bases and Data-Processing

Data-Bases for Institutional and Regents Reporting and Planning

Colleges and universities today are increasing both in size and complexity. As this trend continues, greater effort and information are required to maintain the operation of these institutions. This requirement is partially satisfied by the speed and flexibility of the computer, permitting administrators to utilize data and information to become better aware of how their institutions function.

As mentioned earlier in the report, one of the two principal reasons for maintaining a computer center on a university or college campus is to provide the regular day-to-day administrative data-processing for the institution. Presently, the Regents' institutions are using computers for processing four general types of administrative data: (1) payrolls, personnel files, accounting records, disbursement vouchers, and fee collections--mechanical tasks which are essential and time-consuming by manual methods; (2) student records, admissions, registration, class scheduling and student assignment, grade reporting, and other tasks of a routine clerical nature for the registrar; (3) automated library processes for circulation systems, ordering, acquisition, cataloging, distribution, and accounting; (4) transactional records and reports for such auxiliary activities as the alumni office, endowment association, union, health service, athletic association, housing and food service, and other ancillary services of the institution.

Not all of the Regents' institutions are doing all four types of administrative data-processing. The three colleges and Wichita State University are doing the first two types with varying degrees of sophistication in computer techniques, and while K.U. and K.S.U. may not have exploited all of their potential in the areas mentioned, they have made significant progress.

Unfortunately, the colleges and universities in Kansas are possibly too complacent about the uses of computers for administrative and management purposes. Too often the computer has merely been superimposed on an already archaic system. This has been true particularly in the enrollment and registration of students. The original system was placed on a punched-card system and now, on some of our campuses, the magnetic tapes and disk packs are merely images of the original card system. There has never been a true "systems study" to determine exactly what is being accomplished and how it is being done prior to the design of a computerized system to replace it. Many times such a systems study will reveal many facts that will cause the function to be reorganized and simplified--sometimes even to the extent that it is unnecessary to use the computer at all!

For example, preprinting a form which a student is to complete, using data from his file, is not always feasible. But certainly the student should not be required to furnish basic data about himself repeatedly. Student use of file numbers (social security numbers) may not only reduce the number and volume of repetitive inputs to the system, but may also actually facilitate accurate identification in cases of similar names, nicknames, poor handwriting.

Increased productivity will allow the same functions that are now being performed by manual means to be handled by the computer, increasing the potential capability of these areas. But introduction of the computer into administrative operations of any organization requires a review of existing systems and a modernization of these systems in order to achieve the economies promised by automatic data-processing.

The production of good management information is evidently possible through the application of computer techniques; however, simply having computers on campus and mechanizing some of the functions of the college or university is not enough. "Better" management information is the prime reason for utilizing computer techniques. Better management information is more information, more accurate information, more timely information, more analysis and reduction of information. Unfortunately, few of our Kansas colleges and universities have recognized how important "better information" is to the operation and management of their institutions. The computer and management science are not panaceas for all the problems of a college or university, but can certainly be valuable assets and will be even more valuable when they are fully exploited.

In the same manner that a college or university administrator will be in a better decision-making position when armed with the necessary information, so also will the Regents, who must make policy decisions not just for one institution but for all of the institutions of higher education. To obtain the desired information, the Regents, and state agencies as well, levy reporting requirements on the state-supported institutions. Many of these reports are well-established with respect both to content and to definition of terms. This is true for enrollment information.

There are two beneficial results from this type of reporting requirement: (1) it encourages the use of computers to process the information and produce the required reports and (2) it defines to some extent the information required in the data-base. These two results are far more significant than they appear: when an institution collects, processes, and prepares reports by the use of computers, the administration of the institution is encouraged to utilize the information to provide a firm foundation for decision making.

Common information requested from each of the Regents' institutions of higher education tends to promote compatible data bases at all institutions, with common definitions for the items recorded. When these items are so specified, the effort required of the institution in responding to a request is reduced. This can be a significant improvement.

As the situation now exists, formulation of administrative data-bases and systems in Kansas institutions follows no particular patterns. These data-bases are conceived and built to meet the particular requirements of the institution and may be of no value outside the institution. Unfortunately, there are many areas into which the Regents inquire that are not well defined. A few of these are physical plant, research, extension, and the development of the institution in some program area, such as laboratory schools and R.O.T.C. programs.

The Committee strongly recommends that the institutions be required to develop and coordinate with the Board uniform guidelines relating to its areas of interest and definitions of information to be requested from the institutions of higher learning in the state. The Committee further recommends that these guidelines be formed in such a manner as to encourage the use of computer techniques. This will be beneficial at both the institutional and Regents' level: The information will be more timely, more accurate, and more compatible, if prepared by the computer.

The data-base could be established for use in other areas and could provide information to other systems for overall management reports. The existence of the data-base, once established, could substantially reduce the effort expended by the institution in responding to the request.

Institutional Cooperation on Data-Processing Problems

The urgent need for greater cooperation between institutions is evident to everyone in higher education today. Rising enrollment (129 percent between 1960 and 1970), rising costs (147.5 percent during the same period), a shortage of qualified faculty, and the information explosion are some of the reasons higher education administrators are battling the obstacles of separatism, chauvinism, alumni pressure, and the resistance to change which stand in the way of cooperative efforts.

In the interviews which were undertaken in the preparation of this report, a topic of widespread interest was interinstitutional cooperation, and sharing of resources, talents, programs and systems. The emphasis on sharing is important. Few if any of the institutions can afford a sufficient number of programmers to solve all their data-processing problems in a reasonable time. Most would evidently be willing to adapt their procedures to uniform programs and would likewise be willing to contribute their efforts to the solution of one segment of the total data processing problems. It is obvious that such a procedure can result in improved economies: perhaps not so much a saving in money as a saving in time and effort.

The Committee found evidence that there is a degree of cooperation in the computer field in Kansas higher education institutions in the following instances:

1. The registrars have for a number of years met formally to discuss data-processing problems in regard to enrollment procedures, registration, punched-cards systems, grade reporting, and class scheduling.

2. Discussions of sharing programs and systems are presently going on among the libraries.

3. Formal and informal exchanges of programs, systems, and flow charts have already occurred in the case of the Kansas Union Serials satisfactory conversion to Marc II tapes.

4. Two institutions have installed, and a third is in the process of developing and testing, a library circulation system oriented around the IBM 357 Data Collection System.

This list should be much larger: There are many other ways in which increased sharing and cooperation could help to solve some of the complicated data-processing problems and exploit the full capabilities of computer technology.

One of the obstacles that may slow greater cooperative effort is that each institution (with some justification) regards its problems as unique, although some of the elements of generally useful programs are found in institutions with similar equipment and procedures. Another obstacle may be the absence of specific state-wide plans and goals for development of administrative computing. Thus far its growth has been rapid but unregulated.

The Committee envisions the assignment to each institution of primary responsibility for one or two specific data-processing areas. It would be necessary for the data-processing staff at the institution having primary responsibility to propose, adjust, and effect a solution for the assigned problem. Evidently the assigned institution would also be concerned with the continuing maintenance of the software which was generated.

The entire effort should be guided by a competent planning group in which each institution and its needs are represented. The planning group should operate under the following mandate:

1. The planning group should be well informed about patterns, purposes and costs of administrative computing. It should also be aware of the differing requirements for administrative use of computers.

2. The group should identify a set of goals and should formulate plans for reaching those goals. The group will have to motivate and encourage each institution in carrying out its assigned tasks. It will have to evaluate progress and revise the plan as required, so that the computing needs for the administration of higher education will be met in the most effective manner.

3. The recommendation of the planning group must be made in the context of the funds available for their implementation.

Recommendation 15: As the situation now exists, formulation of administrative data-bases and systems follows no particular patterns. It is recommended that the colleges and universities be required to develop and coordinate standard uniform guidelines and definitions of data-bases to facilitate the routine administrative functions such as registration, grade reporting, class scheduling, library circulation systems, accounting budget reporting, and other functions as they become apparent. Many tasks of a routine clerical nature are now being handled by the use of computers; but in addition to supplementing manpower with computing power (mechanization), many functions could be accomplished better by more efficient methods utilizing the discoveries of both computer and management science to the greatest possible extent.

The introduction of the computer into the administrative operations of any organization requires a review of existing systems and a modernization of these systems in order to achieve the economies promised by automatic data-processing.

Recommendation 16: It is recommended that the institutions pool their resources and talents to develop uniform programs and systems for specific administrative applications such as registration, libraries, accounting and budget reporting. This may well be accomplished by designating each institution to assume primary responsibility for certain specific areas.

CHAPTER VII

Computer Center Staffing

In the rapidly expanding computer field it is difficult at best to maintain competent and experienced staffs. In the State institutions of higher education the situation is further complicated by the fact that unclassified and classified salaries in the State government tend to lag behind the salaries paid for similar work by business and industry. At the same time, the educational institutions have the advantage of a pool of student help which is available at relatively small wages. (A universal practice in university computing centers is to watch the students in computer science courses and to pick off those showing the greatest promise for part-time employment in the computing center.)

Unclassified Personnel

In the college and university computing centers, individuals with professional training and advanced degrees generally hold joint appointments between the computing center and one of the teaching departments of the institution. Because of the rapidly expanding demand for education in Computer Science, their services in the teaching departments are as urgently needed as they are in the computing center itself. Such joint appointments are generally attractive both to the institution and to the individual concerned.

There is usually some financial sacrifice involved in joining an educational institution as compared with employment in a profit-making organization. Even so, it is obvious that salary differentials between the educational institutions and the profit-making organizations cannot be so great that an individual is excluded from taking a position with the educational institution by the economics of the situation. People joining an educational computing center do so at least in part because they wish to enjoy the stimulation of the educational and research activities in the institution, but they cannot afford to overlook gross inequities in salaries.

The demand for experienced computer people with advanced degrees far exceeds the supply. In this kind of a market, it is obvious that salary levels will rise sharply, and while non-profit organizations may lag to some extent, it is still imperative that they keep pace with these salary levels if they expect to maintain and expand their staffs, both in computer science education and in their computing centers.

Competition for qualified computer people exists not only between educational institutions and the profit-making organizations, but also among educational institutions themselves. In this environment, the material and physical fringe benefits as well as the less tangible benefits of institutional and departmental prestige have a strong influence on the decision of candidates. The institution with the weaker reputation must be prepared to provide larger salaries and more substantial material fringe benefits.

Student employees receive valuable training in educational computing centers. While they are students, they are available at relatively small wages but they fully know the value of the services they are rendering. Their services as student employees automatically terminate as soon as they are graduated or receive an advanced degree. Frequently, such student employees become valuable members of the computing center team. It is then incumbent on the center to attempt to retain such people by offering salaries which are reasonably competitive with those which they may earn in profit-making organizations. Failing this, the educational computing center is likely to lose a trained employee who carries with him much extremely useful information and experience.

The K.U. Medical Center, in this regard as well as so many others, is unique. Although it obviously does not have a regular computer science program, it would still be possible for the Medical Center to appoint some people qualified in the aspects of computers and medical research to joint research associate positions. Also, it obviously does not have a ready source of student employees such as is available on the other campuses.

Classified Personnel

In the college and university towns the computing center, like other university activities, can draw many of its classified personnel from among student wives, and other families in the neighborhood needing a second income. It is also possible to attract and retain some people if the administration of the center is willing to adjust the working hours of an individual so that he may attend some classes on the campus. This arrangement is particularly attractive for those people who need full-time employment in order to maintain themselves in the college. In these areas, the termination of a classified employee is more likely to result from the graduation of the employee or spouse rather than from the receipt of a competitive offer.

The situation in the metropolitan areas of Kansas City and Wichita, on the other hand, is completely different: There is a large demand for computer personnel, both from business and from government. On the average, business organizations offer higher salaries for the same type of work than does the State and the fringe benefits are comparable. Consequently, Wichita State University and the K.U. Medical Center have difficulty in getting and keeping classified employees in their computer operations.

The situation at K.U. Medical Center has been particularly acute. At the lower civil service grades, the State of Missouri and the City of Kansas City, Missouri, have been able to offer higher starting salaries than the Medical Center under the current scales of the State of Kansas. The new civil service scale for the State of Kansas has put some of the civil service salaries at the C step above the equivalent starting salaries for civil service work in the City of Kansas City and the State of Missouri. However, adverse competition still exists for some grades.

While one might suppose that student wives would be interested in positions at the K.U. Medical Center, it is equally reasonable to suppose that these potential employees will be looking for positions with the highest current benefits--since they are temporary in the area, they are not usually concerned with long-range fringe benefits such as retirement plans.

Consequently, it has been the experience at K.U. Medical Center that inexperienced people are hired into the lowest grades of the civil service positions, such as keypunch operator I, and are trained until they are efficient workers. Then, before the organization can reap the benefits of the training offered, these employees are hired by other employers on the basis of their experience.

This is evidently a problem which affects all State agencies located in metropolitan areas and it must be dealt with on a State-wide basis by the State Department of Administration. It is suggested that annual reviews of civil service salaries, particularly in the computing area, be undertaken. It is also suggested that some degree of non-uniformity--allowing salary differentials for civil service employees in metropolitan areas--may be desirable.

Recommendation 17: The computer field is expanding more rapidly than a rapidly expanding economy. Consequently, the colleges and universities, particularly those in metropolitan areas, are finding it difficult to attract and retain qualified personnel, both classified and unclassified, on their staffs. It is recommended that the Personnel Division of the State Department of Administration be encouraged to review and redefine the specifications and salaries for classified positions in the computer area, with a view to placing the colleges and universities, as well as all other State agencies, in a more satisfactory competitive position in the market for computer personnel.

APPENDIX

Questionnaire Sent to All Regents' Institutions

State of Kansas
Board of Regents
Topeka, Kansas

October 16, 1968

Computer Study Questionnaire

Part I

INVENTORY

Please inventory all equipment on your campus satisfying the following definition:

Any equipment capable of use or intended for use in a general-purpose computing or information processing environment.

Include, for example, digital plotting equipment; teletypes and other keyboard terminal devices used to communicate with computers, either on or off your campus; desk calculators or accounting machines originally valued at $2,000 or more; analog-digital conversion equipment; general-purpose computers used for on-line data-collection; disk packs; keypunches and other unit record equipment; mark sensing devices.

You may exclude pure analog computers; magnetic tape Selectric typewriters (MTST) and Flexowriters; desk calculators and accounting machines originally valued at less than $2,000; reels of magnetic tape; file and storage cabinets; support equipment such as bursters, decollators, shredders; special purpose digital devices originally valued at less than $2,000.

Detail requested. Please furnish the following information on each type of equipment in your list. (All units with substantially identical characteristics at the same location may be listed as a single entry.)

(a) Quantity

(b) Manufacturer
and short descriptive name (e.g. sorter, CPU, printer, etc.)

(c) Model or type identification (complete as possible)
Each component of a computing system should be listed separately--e.g. 1401E1, 1402, 1403-3

(d) Date of installation

(e) Item replaced by this unit, if known

(f) Type of acquisition (rent, purchase, or lease-purchase)

(g) Cost of gross rental, purchase, or equivalent monthly payment on lease-purchase

(h) Monthly maintenance cost, if any

(i) Discount or educational allowance in dollars

(j) Net monthly cost (rental, maintenance, or lease-purchase plus maintenance)

(k) Physical location--use generic term, not the name of a building: e.g. computing center, library, E.E. Dept.

(l) Academic or Administrative Department paying for unit

(m) Estimate of average "power-on" time in hours per week

(n) Estimate of average productive time in hours per week

Part II

CURRENT STATUS

Furnish a one or two page description of the current status of computing and data-processing on your campus. Sample questions you might attempt to answer are:

(1) What academic departments make use of the computer in course work? In unsponsored research? In sponsored research?

(2) What administrative divisions have current data-processing applications? What are they?

(3) Does the Library use the computer? How?

(4) How is the computer center financed?

(5) How is computer service allocated and charged to the user?

(6) Is any computer service made available to off-campus users? If so, what kind of organizations? How much do they contribute to the expense of operating the computer facilities?

****Please add further information you feel is pertinent.****

Part III

PLANS AND PROJECTIONS

Furnish a one or two page description of your immediate and long-range plans. Sample questions you might attempt to answer are:

(1) What do you think the scope of computing on your campus should reasonably be in two years? In five years?

(2) What additional academic departments do you expect will become involved? How?

(3) What do you see for the future development of administrative data-processing activities? What about data-processing activities in other areas (e.g. library, health center, etc.)?

(4) What do you think your institution should reasonably spend for all computing in two years? In five years?

****Please add further information you feel is pertinent.****

Part IV

GENERAL COMMENTS

We are interested in your point of view on college and university computing in the State of Kansas. Please answer in at most two pages.

#70

References:

1. *Computers in Higher Education*, Report of the President's Science Advisory Committee, U.S. Government Printing Office, February, 1967.
2. *Digital Computer Needs in Universities and Colleges*, Publication 1233 National Academy of Sciences - National Research Council, 1966.
3. *The Challenge of the Computer Utility*, Douglas F. Parkhill, Addison-Wesley, 1966.
4. *The Future of the Computer Utility*, C. C. Barnett, Jr. and Associates, American Management Association, 1967.
5. *Computers on Campus*, John Caffrey and Charles J. Mosmann, American Council on Education, 1967.